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PROCEEDINGS OF

THE LINNEAN SOCIETY OF LONDON

157th Session (1944–45) Part 1

CONTENTS

Page

Proceedings, 26 October 1944 1

Photographs of fasciation in the Spear and Marsh Thistles. By J. H. Owen. [Title only.] 2

Persistent growth in the Tortoise, *Testudo graeca*, for thirty-eight years. By S. S. Flower. [Title only.] 2

Observations on the flowers of *Impatiens glandulifera* Royle. By E. M. Delf. [Abstract.] 2

The salivary glands of Snakes. By Malcolm Smith and A. Bellairs. [Title only.] 3

Proceedings, 9 November 1944 3

Section showing the structure of the curious Rafflesiacea *Sapria himalayana*. By J. Stirling. [Title only.] 3

Some observations on the nervous anatomy and activities of Starfish. By J. E. Smith. [Title only.] 3

[*For continuation of Contents see back page.*]

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Catalogue of the Printed Books and Pamphlets in the Library of the Linnean Society of London. New Edition, London, 1925. (Pp. 860.) 10*s.* net.

General Index to the first Twenty Volumes of the Journal (*Zoology*). . . London, 1896. (Pp. 437.) 5*s.* net.

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The Darwin-Wallace Celebration held on Thursday, 1st July, 1908, by The Linnean Society of London. London, 1908. (Pp. 118.) 2*s.* 6*d.* net.

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—— Part 2. *Caroli Linnaei Determinationes in hortum siccum Joachimi Burseri. The text of the manuscript in the Linnaean Collections,* edited by Spencer Savage, F.L.S. London, 1937. (Pp. 78.) 10*s.* net.

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PROCEEDINGS OF

THE LINNEAN SOCIETY OF LONDON

157th Session (1944–5) Part 1

PROCEEDINGS OF THE GENERAL MEETING
26 October 1944

held jointly with The Zoological Society of London.

Mr. A. D. Cotton, O.B.E., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 22 June 1944, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Dr. L. H. Bailey, Dr. K. Biswas, Mr. I. H. Burkill, Mr. C. MacKechnie Jarvis, Miss F. H. B. Marsh, Mr. S. Savage, Dr. W. H. Thorpe, Prof. F. E. Weiss, Royal English Forestry Society, Messrs. B. T. Batsford and The British Council.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Dr. Ralph Dennell, Dr. Richard Klein, Mr. Frederick Archibald Sowter and Mr. C. MacKechnie Jarvis.

The President reported the deaths of Bertram Lloyd, A. C. Willoughby Lowe, M.A., the Rev. Canon Henry Kingsmill Moore, D.D., Prof. Frère Marie-Victorin, Dr. W. Rushton Parker, Dr. Ethel N. Thomas and Sir Arthur Smith Woodward, F.R.S., Fellows of the Society.

The following resolution, read by the President, was passed in silence, those present standing in their places :—

> The Fellows of The Linnean Society of London having heard with the deepest sorrow of the death of Sir Arthur Smith Woodward, F.R.S., desire to put on record their high appreciation of the services he has rendered to the Society during the fifty-three years of his Fellowship. Especially do they remember that he acted as President from 1919–1923; was four times Vice-President; and served on the Council for five triennial periods. Throughout his Fellowship of the Society he showed the greatest interest in its work. Deploring the loss of so distinguished a Fellow, the Society desires to assure Lady Smith Woodward of its deep sympathy with her in her bereavement.

The Botanical Secretary read a post card, received by Dr. J. Ramsbottom, from Prof. Aug. Chevalier of the Muséum d'histoire naturelle, Paris, stating that the Museum was intact and its collections safe ; but that the deaths had occurred of Prof. Allorge, the Abbé Frémy and M. Hamel ; and that M. Roger Heim had been deported to Germany in 1943.

The following communications were read and discussed :—

Mr. J. H. Owen. Photographs of fasciation in the Spear and Marsh Thistles. [Exhibit ; given on behalf of Mr. Owen by the Botanical Secretary.]

Major Stanley S. Flower. Persistent growth in the Tortoise, *Testudo graeca*, for thirty-eight years. [Given on behalf of the author by Dr. Edward Hindle, F.R.S. ; discussed by Dr. E. Trewavas, Dr. Malcolm Smith, Dr. B. Barnes, Dr. J. Ramsbottom ; Dr. Hindle replied.] [This paper will be published in the Proceedings of the Zoological Society.]

Dr. E. M. Delf. Observations on the flowers of *Impatiens glandulifera* Royle. [Discussed by Dr. B. Barnes, Prof. C. T. Ingold, Mr. I. H. Burkill, Dr. M. Skalińska ; Dr. Delf replied.]

Abstract.—

The observations began with the appearance of a solitary plant of *Impatiens* in a London garden, some ten years ago. It had the typical robust habit and magenta flowers of the plants first reared in this country from seed brought from Kashmir over 100 years ago.

The plant seeded freely and had numerous descendants with a considerable range of variation of foliage, inflorescence and flowers. A number of these have been recorded ; some are illustrated by dried specimens. The flowers ranged from almost white in some plants to a dark purplish red (often maroon) colour, with black splashes on calyx, sometimes also on corolla, both pale and dark extremes being rare. As the flowers change colour on drying, painted records were made of the more marked types as they appeared. One of them resembles the known variety *macrochila* ; another recalls the variety *candida* in many features.

The more characteristic types were distinguished as dark (splashed black, usually) cyclamen, rose, bicolor and pale or very pale ; their colours being specified in terms of the R.H.S. Colour Chart. A considerable range of variation in floral and vegetative features was found in each of these series. In more than one series, several plants were found with leaves in whorls of four, few with opposite decussate leaves, and in several plants the whorled leaves of the lowermost nodes gave way to an alternate arrangement of solitary leaves. Subsequently, flower buds from certain plants were hand pollinated or enclosed in bags for self-pollination and the offspring self-pollinated (usually by hand) for three or more generations. These experiments were discontinued owing to the war, but the results throw some light on the variability and genetic constitution of the species.

Dr. BARNES made some comparison with development of anthocyanin in *Antirrhinum majus* and *Iberis umbellata*.

Dr. MALCOLM SMITH and Dr. ANGUS BELLAIRS. The salivary glands of Snakes. [Discussed by Prof. A. J. E. Cave, Dr. Edward Hindle, F.R.S.; Dr. Malcolm Smith replied.] [To be printed in full in the Journal, Zoology.]

The following paper was postponed to another Meeting :—
Dr. D. LEWIS. The mechanism of incompatibility in seed plants.

PROCEEDINGS OF THE GENERAL MEETING
9 November 1944

Mr. A. D. COTTON, O.B.E., President.
in the Chair.

The Proceedings of the General Meeting held on Thursday, 26 October 1944, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Prof. G. D. Hale Carpenter, Prof. T. G. B. Osborn and Dr. J. Ramsbottom.

The following Fellows signed the Obligation in the Book of the Charter and Bye-Laws and were admitted :—Dr. Sydney Smith and Mr. Collingwood Ingram.

The President reported the deaths of John Melvin Lowson, M.A., Prof. Joseph Hubert Priestley, D.S.O., Fellows; and Thomas Alfred Dymes, Associate of the Society.

The following communications were read and discussed :—

Dr. JAMES STIRLING. Section showing the structure of the curious Rafflesiacea *Sapria himalayana*. [Exhibit given by Mr. I. H. BURKILL, V.-P.L.S., on behalf of Dr. Stirling; discussed by the President and Mr. A. J. Wilmott; Mr. Burkill replied.]

Dr. J. E. SMITH. Some observations on the nervous anatomy and activities of Starfish. [Discussed by Prof. A. Meek, Prof. W. Garstang, Dr. E. Hindle, F.R.S.; Dr. Smith replied.]

PROCEEDINGS OF THE GENERAL MEETING
23 November 1944

held jointly with the Zoological Society of London.

Mr. A. D. Cotton, O.B.E., President.
in the Chair.

The Proceedings of the General Meeting held on Thursday, 9 November 1944, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Dr. J. Wilfrid Jackson, Prof. F. E. Weiss, Dr. L. Richmond Wheeler, and the Imperial College of Science and Technology, South Kensington.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Mr. William Raymond Philipson.

The President reported the deaths of Dr. Douglas Stewart Raitt, F.L.S., and Prof. Gustav Gilson, F.M.L.S.

The following communications were read and discussed :—

Dr. Maria Skalińska. Polyploidy in *Valeriana officinalis* Linn. in relation to Ecology and Distribution. [Discussed by Dr. T. A. Sprague ; Dr. Skalińska replied.]

Abstract.—

This is an attempt to analyse the great diversity within the collective species *Valeriana officinalis* Linn. The research work includes : (A) Field studies of living plants and studies of herbarium specimens from various natural habitats involving a considerable range of morphological forms. (B) Transplant experiments which aimed at the elimination of the influence of various external conditions existing in natural habitats. These experiments have shown that some of the morphological differences are phaenotypic, whereas others express differences in the genetical constitution of the plants. (C) Cytological studies which have proved that some differences, chiefly those concerning the vigour of the plants, are due to differences in the chromosome number. Of the two chromosomic types, the higher polyploid, viz., the octoploid with 56 somatic chromosomes was previously reported as the only type occurring in Great Britain (Todd, 1942). In addition to this type, tetraploids with 28 somatic chromosomes were detected by the writer. There is no sharply marked difference between the two polyploid types, the extremes being connected by a range of intergrading forms. Each of the two types includes a number of more or less distinct forms probably resulting from a purely genic differentiation (e.g., differences in the shape of the leaflets, the toothing of their margins, the pubescence of the stems, the presence of anthocyanin). (D) Studies in ecology and distribution of the two polyploids in Great Britain ; they were based on field studies combined with studies of herbarium specimens. The presumable polyploid type

of the herbarium specimens was estimated from the pollen size in addition to the morphological features which are often misleading. According to the results obtained, the tetraploid type has a much smaller area than the octoploid; it seems to be limited to the southern counties and parts of the Midlands, whereas the area of the octoploids extends from the southern counties to the north of Scotland. The area of the tetraploids seems to follow some definite geological formations: Jurassic (chiefly Oolitic) and Cretaceous (Chalk); in addition, they sometimes occur on Carboniferous limestone in the south-west. Ecologically, the tetraploids represent a xerophilous type growing in a relatively dry soil, in hilly regions, on slopes and in dry valleys. On the other hand, the octoploids occurring within the area of the tetraploids grow at lower altitudes in moist soil, along river sides, on ditch banks. More northwards, however, the octoploids are represented by both hygrophilous and xerophilous forms. Owing to its increased vigour this presumably younger type is capable of a greater expansion than the tetraploid.

Discussion.—

Dr. T. A. Sprague congratulated the author on the extremely interesting results which she had obtained. The data suggested that in *Valeriana officinalis* the change from the tetraploid to the octoploid condition had taken place not once but in many instances, and that the tetraploid and octoploid sets of plants represented not two separate taxonomic groups, but rather two evolutionary stages of one and the same series of taxonomic forms. On the whole, the octoploid set in the Cotswold Hills corresponded to the plants named *V. sambucifolia* by British botanists, but it included also various plants, such as those in Chescombe Wood, which, judging from their external morphology, he had tentatively assigned to *V. officinalis* sensu stricto (Proc. Linn. Soc. Lond. 155 Sess. 1942–3, 96: 1944). He enquired whether the octoploids possessed, on the whole, larger corollas than the tetraploids.

Commemoration of the bicentenary of Lamarck's Birth.

The President made some remarks on Lamarck's relation to the Linnean Society. Dr. A. T. Hopwood called attention to a work in Society's library presented to the Society by Lamarck.

The following papers were read :—

Mr. R. Winckworth. From Linnaeus to Lamarck.

Prof. F. Wood Jones, F.R.S. Time and Lamarck.

(The discussion was opened by Prof. J. B. S. Haldane, F.R.S., followed by Dr. F. E. Zeuner, Dr. K. Mather, Dr. R. Melville, Dr. E. Hindle, F.R.S., Dr. M. J. D. White, Dr. Ursula Philip and Dr. M. Skalińska; Prof. Wood Jones replied.) [Printed in full below.]

'Contributions towards the Fungus Flora of Uganda.—No. VII. New records and revisions (*continued*)'. By C. G. Hansford, M.A., F.L.S. [Printed in full, p. 20.]

COMMEMORATION OF THE LAMARCK BICENTENARY.

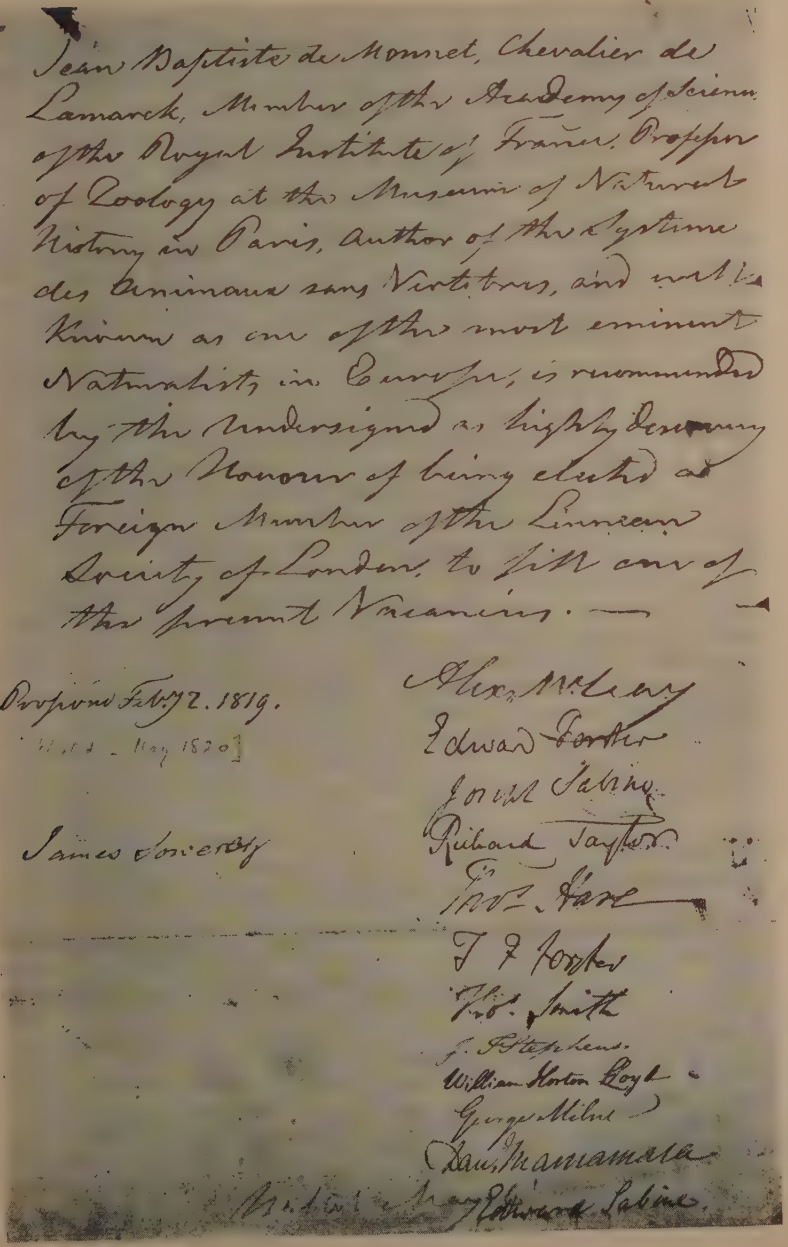
The PRESIDENT made the following opening remarks :—

The second part of our Meeting to-day is set apart to honour the memory of the great French Naturalist, Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck, the bicentenary of whose birth falls this year. Lamarck began by being a botanist. Later he became a zoologist and for many years held an important Chair in the Jardin du Roi at Paris. Botanists and zoologists alike are glad to pay tribute to-day to his memory.

To botanists Lamarck is known by his descriptive works, especially the Flore Françoise and his volumes Encyclopédie méthodique. In the Flore Françoise he gave to his country the first Flora worthy of the name, and by a new and ingenious classification he facilitated the work of identification of species. In it, moreover, he introduced, apparently for the first time, the principle of a dichotomous key. His work in the Encyclopaedia with its 1,000 plates is to this day consulted by botanists, especially those engaged in nomenclatural research.

To zoologists Lamarck's fame rests not only on his descriptive works but, as all know, on his philosophical writings and especially his theory of descent. It is therefore chiefly zoologists who will take part in this Meeting.

Lamarck's association with the Linnean Society must be alluded to. He was elected a foreign member in the year 1820, and the Assistant Secretary has placed his certificate on the table, together with his portrait. The certificate was signed by most of the prominent Fellows of the day. There is one curious fact concerning it, namely, that the name of the President, Sir James Edward Smith, is missing. This was probably due to Lamarck's critical attitude towards the views held by Linnaeus as to the constancy of species. Smith, who, you will remember, had purchased the Linnaean collections, considered this to be a slight on the great Swedish botanist. It may interest Fellows to hear two extracts from his writings. The first is taken from his work entitled 'A Sketch of a tour on the Continent', after he had visited Holland, France, Switzerland and Italy and had made the acquaintance of many botanists and zoologists. 'At Mr. de Jussieu's I sometimes met Mr. de Lamarck, who is equally devoted to botany, in which indeed he is quite absorbed, and whose knowledge is undoubtedly very extensive, but whose character is less pleasing than that of Mr. de Jussieu. This gentleman is engaged in the botanical part of the Encyclopédie, a work which I have been deterred from studying so much as it perhaps deserves, partly by its barbarous arrangement, and partly by the scorn with which it was universally spoken of by scientific botanists in France. [*Footnote*.—"The more I have used it since, the more have I found that I was unduly prejudiced against it".] By this inattention [i.e., failure to use his Encyclopaedia] and, as I am told, by neglecting to visit him, I unfortunately incurred the public censure of Mr. de Lamarck".—Smith was a young man of twenty-seven when he visited the Continent, though his journal was written later.



Jean Baptiste de Monnet, Chevalier de Lamarck, Member of the Academy of Scienc. of the Royal Institute of France, Professor of Zoology at the Museum of Natural History in Paris, Author of the Système des Animaux sans Vertèbres, and well known as one of the most eminent Naturalists in Europe, is recommended by the Undersigned as highly deserving of the Honour of being elected a Foreign Member of the Linnean Society of London, to fill one of the present Vacancies. —

Proposed Feby 2. 1819.

[illegible - May 1820]

James Sowerby

Alex. McLeay
Edward Forster
Joseph Sabine
Richard Sayer
Jno. Hare
J. J. Vorley
Jno. Smith
J. Pettiplace Lewis.
William Horton Lloyd
George Milne
Dan. Wm. Mackenzie
[illegible] Edward Sabine.

The second extract, written very much later, reads :—

'We dare not presume to arrange the indefatigable and very original botanist Lamarck among the Linnean botanists of his country ; but we beg leave to mention him here, as one who has thought for himself, and whose works are the better for that reason . . . '

FROM LINNAEUS TO LAMARCK

By R. Winckworth.

Jean Baptiste Pierre Antoine de Monet de Lamarck, the eleventh child of a Picardy seigneur, was born 200 years ago on 1 August. You may remember the story of how, when only sixteen, he left the Jesuit college at Amiens and volunteered in the Netherlands war : the day after enlistment he found himself among some grenadiers in battle ; in the confusion of retreat this company was forgotten ; all the officers were killed, and Lamarck, inexperienced and youngest among them, took charge of the remnant and held the position until relief came. An accident put an end to his army career and he went to Paris to study medicine. Meteorology, chemistry and physics attracted him, but his interest centred on natural history and led him specially to botany. In this subject his work soon attracted attention, and he was elected to the Académie des Sciences in 1779 as assistant, in 1783 as associate, and become one of the twenty members, first class, in 1795. He was the first to use dichotomous keys in natural history in his 'Flore françoise' of 1778, a feature still found in the latest edition of Bentham and Hooker's 'British Flora'. Lamarck's initiative and imagination lit up every subject he touched. It is to him we owe the idea of a water-table. He gave the first account of the fossils of the Paris Basin. He proposed a theory of evolution, which still has adherents to-day.

In 1793 the Jardin du Roi was reorganized ; Lamarck gave up botany and was given a chair of zoology with the special subjects of Insecta and Vermes, which in the Linnaean sense cover all invertebrates. But it is to the mollusca that I shall chiefly refer ; for these animals and their shells were his favourite study. He arranged them in an ordered assemblage with such insight, that even to-day, a century and a quarter later, the Lamarckian outline is clearly discernible in modern systematics.

The astonishing clarity brought into zoology by the binomial system and the 'Systema Naturae' of Linnaeus dazzled the scientists of Europe. All the earlier systems, even those of Klein and Adanson, fell into insignificance, after the tenth edition of the 'Systema' appeared in 1758. The authority of Linnaeus prevailed everywhere for the next generation : his advice to be cautious in introducing new genera was widely followed. Even O. F. Müller, who knew the animals of Denmark and the Danish seas intimately, in his 'Prodromus' of 1776 follows Linnaeus closely. He transfers *Vespertilio* to Glires, and in Vermes, his special study, makes a slight rearrangement of the orders ; the Linnaean genera are retained unaltered with very few exceptions, such as the separation of *Pecten* from *Ostrea* and of *Terebratula* from *Anomia*.

The same conservatism is seen almost everywhere in the last forty years of the eighteenth century and the early eighteen hundreds. The innovators were few in number and their genera not widely accepted. Those whose work appealed to a wider public had to seek safety in the Linnaean system. The genius of Linné had sterilized systematics even in Testacea, which must be accounted the least satisfactory part of the 'Systema'.

Linné's System.

Mammalia	Primates : Bruta : Ferae : Glires : Pecora : Bellua : Cete.
Aves	Accipitres : Picae : Anseres : Grallae : Gallinae : Passeres.
Amphibia	Reptiles : Serpentes : Nantes.
Pisces	Apodes : Jugulares : Thoracici : Abdominales.
Insecta	Coleoptera : Hemiptera : Lepidoptera : Neuroptera : Hymenoptera : Diptera : Aptera.
Vermes	Intestina : Mollusca : Testacea : Lithophyta : Zoophyta.

Lamarck's System.

Invertebrata Apathetic	1.	Infusoria — Nuda : Appendiculata.
	2.	Polypi — Ciliati : Denudati : Vaginati : Natantes. (rotifers hydroids polyzoa crinoids)
	3.	Radiaria — Mollia (jellyfish) : Echinoderma.
	4.	Tunicata — Botryllaria : Ascidiaria.
	5.	Vermes — (Taenia, Filaria, Lernaea, etc.)
Invertebrata Sensitive	6.	Insecta — Orthoptera added to the Linnaean orders.
	7.	Arachnida — (centipedes, etc. : pycnogonids : scorpions and spiders).
	8.	Crustacea — Heterobranchia :—Branchiopoda : Isopoda : Amphipoda : Stomapoda. Homobranchia :—Decapoda.
	9.	Annelida — Apoda : Antennata : Sedentaria. (leeches polychaetes)
	10.	Cirripedia — Sessilia : Pedunculata.
	11.	Conchifera — Dimyaria : Monomyaria.
	12.	Mollusca — Pteropoda : Gasteropoda : Trachelipoda : Cephalopoda : Heteropoda.
Vertebrata Intelligent	13.	Pisces
	14.	Reptilia
	15.	Aves
	16.	Mammalia

Cuvier's System.

1797 Embranchemen	1817	
Animaux à sang rouge	Vertebrata	Mammalia : Aves : Amphibia : Pisces.
Mollusques	Mollusca	Cephalopoda : Pteropoda : Gasteropoda : Acephala : Brachiopoda : Cirrhopoda.
Insectes et Vers	Articulata	Annelida : Crustacea : Aranea : Insecta.
Zoophytes	Radiata	Echinoderma : Entozoa : Acalephae : Polypi : Infusoria.

In France, however, where the spirit that led to the revolution helped to diminish respect for authority, the chains of Linnaean genera were to be loosened. The two great men were Cuvier and Lamarck. In connexion with molluscs one must also mention Draparnaud's classic

work on the French land and freshwater fauna, and the excellent Bruguière, who died in 1799; one wishes he had lived to complete the volume on Vers in the 'Encyclopédie Méthodique'. Bruguière had begun a critical revision of the Linnaean genera as early as 1789; many were divided; new genera, e. g. *Trigonia*, introduced; and post-Linnaean genera such as *Pecten* and *Bulimus* recognized. Lamarck adopted and expanded these ideas. Cuvier, more cautiously, introduced most of the non-Linnaean genera he used as sous-genres.

In 1799 Lamarck published a 'Prodrome' of a new classification of shells with 126 genera in place of Linné's 37. Two years later appeared Lamarck's 'Systême des Animaux sans vertèbres', where the genera we should put in the phylum Mollusca now number 148 to become 220 in the 'Histoire'. One may note that Lamarck introduced the terms vertebrate and invertebrate in place of the Aristotelian blooded and bloodless animals (*ἔναιμα* and *ἄναιμα*). From Cuvier he adopted the term Mollusca, which had been a mixed assemblage of coelenterates, echinoderms, polychaetes, molluscs, etc., in Linné, instead of Testacea. The system was further developed in 1812 and presented in full in the 'Histoire naturelle des Animaux sans vertèbres' by 1822. Brachiopods puzzled him and are retained with bivalves as a 'famille remarquable'. Cirripeds and tunicates are rightly removed from the Mollusca, a correct procedure, not generally recognized owing to the influence of Cuvier. It was that remarkable observer J. V. Thompson who in 1830 fully proved the crustacean affinities of barnacles, while it was not until Kowalewsky in 1866 described the development of *Ascidia* that tunicates were finally divorced from molluscs and their affinities with vertebrates discussed.

Lamarck appears to have been on friendly terms with Cuvier; at least they freely exchanged ideas: but, as Dr. A. T. Hopwood has shown in an address given on 1 August, the friendliness was maintained by Lamarck's open nature, while Cuvier nursed a growing envy, culminating in the shocking éloge he read after Lamarck's death in 1829. Both Cuvier and Lamarck were prodigious workers and brilliant men, but Cuvier lacked originality, though he was quick at following up ideas: perhaps his sole original idea in zoology was the important one of seeing the animal kingdom as composed of separate 'embranchemens' instead of a single array. Both published surveys of the animal kingdom about the turn of the century: Cuvier's 'Tableau' appeared in December 1797, Lamarck's 'Systême' in 1801. Each was followed twenty years later by maturer and fuller accounts: Cuvier's four volumes of the 'Règne animal' in 1817, Lamarck's 'Histoire naturelle' in 1815–1822. Cuvier's work was based on a large number of animal dissections; his system divides animals into four divergent branches; herein lay the seed of the genealogical tree of nature. To Lamarck nature was a ladder of successive steps. But Lamarck's genius, wealth of imagination, power to discern essentials and ability to state those essentials clearly and concisely made the 'Histoire naturelle' for zoologists, and especially for students of mollusca, a text book that illumined the way for the next century. The bonds of Linnaeus were broken, and to many it seemed that a greater than he had interpreted nature. Cuvier was the forerunner of Owen and Huxley: but Lamarck was, brilliantly, the apotheosis of Linnaeus.

TIME AND LAMARCK

By Frederic Wood Jones, D.Sc., F.R.S.

During this year that marks the bicentenary of the birth of Lamarck many tributes will be paid to his memory as a great naturalist. Praise will be given in full measure to his prodigious industry and to his remarkable insight into the affinities and the ordering of a vast array of living things studied with patient devotion at a time of life when most men are already ceasing from their labours. But it is very doubtful if there will be many who will accord him great honour for enunciating those views upon heredity that are popularly associated with his name.

One claim to distinction that should not be overlooked in estimating Lamarck's work was his very real appreciation of the value of the time-factor in all cosmic processes. Living in an age when orthodox opinion sanctioned a belief in only a comparatively limited interval between the creation of the world and the year 1774, Lamarck declared boldly that the past was almost limitless. Buffon, before him, had pronounced his dictum that 'Nature's greatest workman is Time'. But Lamarck was brave enough to reject the prevailing belief in cataclysms and sudden changes in cosmic processes and to claim that 'Nature has no difficulty on the score of time; she has it always at command; it is with her a boundless space in which she has room for the greatest as for the smallest operations'.

We who live in an age of perpetual haste in which the annihilation of time seems to be on the road to accomplishment have almost begun to believe that we have the power to hasten the processes of Nature. We live in an age that has come to regard man-made experiment as an almost infallible test of truth. We have therefore perhaps become wont to indulge in a vain assumption that what man cannot achieve by means of his puny experiments, carried out during his ridiculously trivial span of time, has proved impossible for Nature with limitless time at its disposal.

Lamarck's true appreciation of the importance of an immensity of time in all the processes connected with the ordering of living things must be ranked as one of his outstanding contributions to the thought of his day, and I for one believe that time, in its turn, will serve him well, for I venture to prophesy that long before his tercentenary is celebrated, the validity of his views on the manner of hereditary change in living things will have been universally admitted and acclaimed.

It is surely one of the strangest circumstances in the history of scientific thought that views as to the transmission of acquired adaptive characters that had been arrived at in independence by three such men as Buffon, Erasmus Darwin and Lamarck, and that had been advocated in varying measure at different times by Charles Darwin, should have fallen so readily into disregard and ultimately into disrespect. Charles Darwin persuaded the world to believe in the reality of evolution, but his triumph did not establish a belief in the inheritance of acquired characters.

Three years after Charles Darwin's death, August Weismann captured contemporary biological thought by enunciating his 'Theory of the Continuity of the Germ-plasm'. By most biologists this theory was

welcomed, for it was accepted as dealing the death blow to any lingering belief in the inheritance of acquired characters or to what by then had become branded as Lamarckism. After 1885, most of those who still clung to Lamarckian beliefs cherished their creed in secret, for Weismannism carried the day in consequence of the vigorous championship it received from most leading biologists. But no Lamarckian need have recoiled from the impact of Weismann's doctrine since, within a few years of its publication, many of its fallacies were exposed, and to-day no man who has belief in the theories of heredity of Buffon, Erasmus Darwin and Lamarck need give a second thought to the 'Theory of the Continuity of the Germ-plasm' for the theory is no longer tenable. In 1885 it was confidently expected that Weismann's work would initiate a new era and that the study of evolution would receive a new stimulus and reap a rich reward. But only five years after its publication Bateson confessed that 'in the study of evolution progress had well nigh stopped'. He wrote these words when he was giving to the scientific world the rediscovered works of Mendel. After 1900 there was no more discussion of the rival claims of Lamarck or of Weismann, for all men's minds were directed to 'particulate' heredity and to Mendelian principles. 'Use' and 'disuse', 'adaptation' and 'environment' passed out of the language of heredity and 'wrinkled' and 'smooth', 'recessive' and 'dominant' became their substitutes. It might almost be said that the study of heredity shrank from discussion of the modifications and adaptations of the whole living organism to estimations of the wrinkled skin of its seed or the trivial variation of its colour or pattern or proportion. From general heredity the inquiry narrowed to particulate heredity, and although studies of particulate heredity might conceivably have become so extensive as ultimately to embrace all the characters that make up an entire organism this synthesis still appears to remain as distant as it did in 1900. Without levity it might be said that while Mendel's work threw much light on the inheritance of wrinkled seeds it forgot the garden pea that produced them. Again, without treating the subject over-lightly, it might be claimed that if Weismannism was not actually dead in 1900, it should have been, for outside the immediate circle of its propagandists its fallacies were glaringly apparent. But one concept from Weismann survived overtly and fell into the lap of the Mendelians. Weismann had put forward the hypothesis that it was the nucleus of the sex cell that alone carried the factors of inheritance and, more than that, it was only the chromosomes in the nucleus in which this potency resided. The 'idioplasm' of Naegeli (1885) was, according to Weismann, definitely localised in the chromosomes. Chromosomes break up, divide, reunite and behave as particles within the nucleus and so they were naturally hailed as the proper agents for the production of particulate inheritance. The alternative characters of 'wrinkled' or 'smooth' could be pictured as residing as gemmules or factors upon the thread-like length of the chromosome bodies. Bateson, the Mendelian, proceeded to the shrine of Morgan, the Drosophilist, and the gene took permanent place and entered upon its amazing career. The gene was born under a lucky star. It had a successful career predestined at its birth by reason of the atmosphere of thought into which it was born. The Mendelian

returned from his visit to the Drosophilist (as D'Arcy Thompson has recorded) 'convinced and humbly marvelling'. Heredity, it was claimed, was to be become an exact science. Genes could be shuffled about, rearranged or even suppressed in so convenient a fashion that of the subject of heredity as a whole it was possible for East to write in 1925 that 'its principles are not more complex than those of auction bridge and are a good deal like them'. Possibly this is true of the manoeuvring of genes and chromosomes and so of such characters as 'wrinkling' or 'smoothness' of the seed. But there still seems to be some neglect of the whole garden pea plant that produced the wrinkled seed, for it, as much as its wrinkled seed, is the product of heredity.

The omnipotence of the nuclear chromosomes in heredity did not pass unchallenged even in the first decade of the twentieth century. There were some who fancied that too much was given to too little, and that in the exclusive consideration of certain particles in the nucleus there was some neglect of the vastly more abundant cytoplasm of the sex cell itself. Did the cell as a whole carry nothing and mere parts of its nucleus carry all ?

At this point several lines of thought seem to converge. Von Baer (1792–1876) had shown that, in the development of the individual, the characters of the great group to which it belonged appeared in the embryo before those of its more special group and these in turn before those that distinguished it as a separate species within its particular group. Roux (1850–1924) had postulated two stages in embryonic development, the first 'the period of direct fashioning through the formative mechanism implicit in the germ-plasm'; the second which 'adds the finishing touches to the finer functional differentiation of the organs'. Boveri (1862–1915) also postulated two phases in the unfolding of the hereditary characters of the embryo. The first was the 'cytoplasmic' stage, the second was the 'chromosomic'. Could we make a synthesis of the postulates of these three great biologists ? Did we do so we should suppose that Von Baer's ultimate specific characters and Roux's finishing touches fell into Boveri's 'chromosomic' phase and in arriving at that conclusion we should come into complete agreement with Boveri, who claimed that the specific characters were transmitted exclusively by the chromosomes. We are equally free to suppose that Boveri's 'cytoplasmic' stage of hereditary transmission finds its parallel in Roux's first period of 'direct fashioning through the formative mechanism implicit in the germ-plasm', and Von Baer's early phase of the unfolding of the characters of the family and the phylum to which the individual belongs. It might perhaps be said that the fluctuating factors of the 'dwarfness' or 'tallness' of Mendel's garden peas were rightly postulated as residing in particulate entities in the chromosomes of the nucleus, but the fact that the garden pea remained a garden pea throughout all the generations embraced in the experiments was due to the 'formative mechanism' implicit in the cytoplasm of the sex cell itself. There is nothing novel in such a finding, for in the U.S.S.R. Lysenko and his colleagues have been strenuous advocates of cytoplasmic transmission of hereditary characters almost to the exclusion of consideration of nuclear transmission. In doing this they have probably swung the pendulum too far in the other direction. The orthodox Mendelians

saw all hereditary characters transmitted by genes lodged in the chromosome of the nucleus. The modern school in the U.S.S.R. sees in the cytoplasm of the cell the vehicle of transmissible hereditary characters. It is not in a mere spirit of compromise that it might be urged very cogently that specific characters—the little non-adaptive, and mainly non-functional fluctuations of pattern, colour, texture, proportion or what-not that serve to distinguish one species from another and are the last finishing touches of development, are all that nuclear genes are competent to control. It is these last little finishing touches that are at times exempt from the scope of Dollo's law of the irreversibility of structural evolution. Should this be a just picture of the minor rôle of the once all-powerful genes, we are free to suppose that the cytoplasm of the cell itself is in some way (possibly by the agency of the hypothetical 'plasmogenes') responsible for the transmission of all the major characters of the organism. That these major characters are adaptive, fitting the particular form of the organism to its mode of life and to its environment and that they have been 'acquired in response to use or environment' is, I think, not to be denied. Could we not agree two hundred years after the coming of Lamarck, to give to the Mendelian drosophilists all the nuclear, chromosomal genes they require for the transmission of the 'finishing touches', the specific minutiae and the non-adaptive trivialities of pattern, coloration, proportion and all the rest of it? And could we not ask that in return they give to others the wider field of the cytoplasm containing the hypothetical idioplasts, gemmules, plasmogenes or whatever they may chance to be, for the transmission of the fundamental, adaptive and necessarily acquired characters that make the organism what it is? For that adaptive characters, acquired in response to use or environment, are transmitted as certainly as are the non-adaptive specific characters is not to be denied.

Man may have satisfaction in believing that his short-term experiments have made him master of one of Nature's secrets of heredity, but he must not be blind to the fact that, in his brief span, he is not able to follow the working of them all. He does not share with Nature the advantage that time is 'a boundless space in which she has room for the greatest as for the smallest operations'.

Had Man's study of experimental genetics been coincident with his own emergence as *Homo sapiens* we might to-day be celebrating the vindication of Lamarckian principles as they are manifest in the adaptive modifications that have produced our own peculiar Head Louse, fitted for Life in the specialized environment of our scalp hair. We might also be congratulating ourselves on the experiments that are leading to the acquired adaptations that, distinguishing our Body Lice from our Head Lice, were started on the day on which our ancestors first donned clothing.

Discussion.—

Prof. J. B. S. Haldane, F.R.S., said that even if we reject the cause for evolution which Lamarck postulated, we must realize that to describe the historical facts and to postulate an intelligible cause for them were enormous developments in biology for which he will always be honoured.

Professor Wood Jones now suggests that characters acquired in a Lamarckian manner are carried by the cytoplasm, and that these are of more importance and developed earlier in ontogenesis than the Mendelian ones carried by the nucleus. He further postulates that these cytoplasmic characters are responsible for the main differences between species. It is perhaps worth noting that many Mendelian characters appear quite early in ontogenesis. Two of these with which Mendel himself worked affect the cotyledons. If Professor Wood Jones's hypothesis were correct, we should expect species hybrids to resemble their mothers very much more closely than their fathers. As a matter of fact, in the majority of cases, reciprocal hybrids are indistinguishable, provided they are not studied at such an early stage that the paternal genes have had no time to act. It remains to be proved that the effects of use and disuse are ever inherited. It is certain that in one very important case they are not. The non-reproductive workers and soldiers of insect societies have very precise instincts which in other species a Lamarckian could explain as inherited habits. However, since almost all their ancestors have been sexual individuals with quite different behaviour, it is clear that if instinct were inherited memory, they would lose their existing instincts. The same applies to their special morphological characters.

Dr. F. E. Zeuner. An essential difference between geneticists and Lamarckists lies in the attention paid to the time-factor in evolution. The Lamarckian theory always reckons with periods which are considerable, Lamarck himself spoke of thousands and millions of centuries ; whilst the Geneticist as a rule neglects this rather important aspect of evolution entirely. I hasten to say that there are conspicuous exceptions. Professor Haldane, for instance, said in ' Possible Worlds ' (1940, p. 39) : ' It must be remembered that, however many experiments fail, it is always possible that the effects of use and disuse may be impressed on a species at a rate not susceptible of experimental verification, yet rapid enough to be of importance in geological time '. This statement will be wholeheartedly agreed to by all who hold Lamarckist views.

It is worth noting that the time factor was not forgotten by the original Darwinists, nor even by Weismann, who admitted that it is by no means to be implied in his theory that the structure of the germ plasm may not possibly be altered by a direct action of external influences continuing for a *very long time*. But Weismann was hopelessly underestimating the length of time available for evolution, since he was satisfied with the evidence provided by Egyptian animal mummies which showed that no changes had taken place in the last four thousand years. Probably as a result of Weismann's great influence on the subsequent development of research on evolution, his views concerning the ineffectiveness of time also came to be accepted as the final word in the matter. Lamarckists, however, continued to stress the importance of the time-factor (for instance, Eimer, Wood Jones).

Now the question how long it takes for changes in characters of species to become noticeable, can be answered to a certain extent. Since I first came across this problem of the time-factor in evolution some fifteen years ago, I have tried to collect evidence. The chief pre-requisite is, of course, the establishment of geological time-scales sufficiently accurate

to be applicable to our problem. Fortunately, such time-scales exist. The second pre-requisite is that fossil remains are available in sufficient abundance to provide (*a*) a closely covered lineage in time, i.e., specimens from many deposits of different age, and (*b*) contemporaneous assemblages which provide some idea of individual and geographical variation during any particular chronological stage. It is obvious that few lineages have as yet been worked out which may be regarded as reasonably satisfactory, but those available have yielded most interesting results.

Instances based on palaeogeographical and climatological considerations. Before giving palaeontological evidence it may be pointed out what ages have been ascribed to some recent subspecies on the evidence of palaeogeography and climate. Two species of Orthoptera of a southerly distribution (*Platycleis occidentalis* and *Euchorthippus declivus*) have been isolated on the island of Jersey and produced distinct subspecies within 7–10,000 years. The extinct British race of the Large Copper Butterfly (*Lycaena dispar*) has been isolated from Continental races for about 15,000 years. Moreau suggested that birds evolved new subspecies in Egypt within 5–10,000 years, and Huxley agrees to the view that something like 10,000 years is necessary for the production of a taxonomic subspecies.

Instances based on fossil evidence. Fossil evidence confirms this. The British Red Deer (*Cervus elaphus scoticus*) is regarded as a subspecies and is not older than about 7,500 years, since fossils antedating the breakdown of the English Channel belong to the Continental race. The British form, however, appears to be merely phaenotypical; when introduced into New Zealand, it changed into a form resembling the Carpathian strain of the Continental subspecies (Ritchie, 1920). The marmot (*Marmota marmota*) of the upper Pleistocene (70–100,000 years ago) shows a variability in the temporal ridges which has since disappeared, and a form of *Capra ibex* which cannot be regarded as more than a subspecies, existed in the middle Pleistocene, 230,000 years ago. Not one instance has been found of changes having taken place within the last quarter of a million years, which would be regarded as justifying specific distinction. To find these, one has to go back to the lower Pléistocene (500,000 years ago). Here one encounters a good many specific differences, and some lineages can be traced to the upper Pleistocene, or the present day (*Elephas meridionalis -antiquus*, *E. meridionalis*—mammoth, *Dicerorhinus etruscus—merckii*, the Giant Deer, *Ursus arvernensis—arctos*, etc.).

This and other evidence, discussed in some forthcoming publications by the speaker, appears to suggest that, in mammals, 500,000 years is the minimum time normally required for the evolution of a new species. At the earliest stage accessible to investigation the character which later becomes specifically differentiated, is still unstable. It varies and includes as extreme variants those which become typical of the descendant, 'new' species. The intermediates disappear in the course of time. The initial variability coincides, in the case of European Pleistocene mammals, with repeated rapid changes in the environment, and at least in the case of the elephants, the changing characters of the two divergent lineages are clearly adaptive, and the change is gradual.

In other groups, like the mollusca and insects, the rate of species transformation appears to have been rather slower than in the mammals. The longest period for which species appear to have persisted unaltered is something like 30 million years.

In considering the lineages quoted, and others, one gains the impression that the number of generations has less to do with the rate of evolution than is generally supposed. It is by no means so that groups with a rapid succession of generations, like insects or mice, evolve faster than those with a slow one, like elephants or rhinos. This point needs further study, since, if true, it would show that attempts to prove changes experimentally by using species with a rapid succession of generations may be based on a fallacy.

Finally, palaeontological evidence makes it very difficult to accept Goldschmidt's suggestion that, though subspecies may be formed by environmental factors acting on the genes, species formation is on a totally different plane.

Thus, the study of the time-factor in evolution by palaeontological methods suggests that on the whole characters change gradually and often adaptively and that there is no clear-cut line between minor forms, subspecies and species. If and when acquired characters become inherited, it is a matter of periods of time which are beyond the grasp of the experiment. The modes of species formation suggested by genetics, however, would lead one to expect comparatively short-timed and abrupt changes. The chronological evidence, therefore opens the way to a re-consideration of Lamarck's theory on a sounder and more factual basis than he, the naturalist philosopher, was ever inclined to use. But although the introduction of the time-factor into the discussion of evolution renders Lamarckian conceptions tenable, the evidence for the latter has to be morphological, such as Professor Wood Jones's squatting facettes. It has been pointed out many times in the past, and is still true that inheritance of acquired characters may well exist beside the various modes of species formation suggested by genetic research.

Dr. K. MATHER said that two points raised by Professor Wood Jones called for further comment. In the first place there was his statement that geneticists had concerned themselves only with nuclear heredity, and that consequently the importance of the cytoplasm as the agent of a general heredity had been overlooked. Geneticists were, however, unaware of the outcome of their investigations before making their crosses, and hence would have no means of rejecting cytoplasmic heredity from their investigations except by the deliberate suppression of results, for which conduct there was no evidence. In fact many cases of cytoplasmic inheritance had been investigated and reported in plants. The characters involved, chlorophyll deficiencies, male sterility and so on, were also known in other cases to be brought about by nuclear genes. Thus there was no reason to suppose either that cytoplasmic heredity had been overlooked by geneticists, or that the phenotypical differences it determined were essentially different from those controlled by the nuclear genes.

Secondly, Professor Wood Jones alleged that the nuclear genes controlled differences of only an unimportant and non-adaptive nature.

Though this could perhaps be said of the genes of major effect, so familiar in laboratory experiments, other nuclear genes affecting quantitative variation, such as stature in man, were in a different category. They seemed to provide all the material necessary for the production of evolutionary and adaptive change. In particular, in the case of *Petunia axillaris* and *P. violacea*, specific difference in corolla shape, a character widely recognized as adaptive in the influence it exerted on pollination, could be shown to be under the control of nuclear-borne genes.

The position was that genetics had failed to reveal any evidence of directed mutation such as Lamarckism demanded. It had in fact shown that mutational changes were random in effect and that genes were subject to changes in frequency through the action of natural selection. No case had been shown to be incapable of explanation on the basis of undirected mutation and selective change. Thus, while it was impossible to say that changes of a Lamarckistic nature too slow to detect in experiment had never occurred over the long periods of evolutionary time, the hypothesis was an unnecessary one. It must remain so until genetical experimentation revealed a case of directed mutation, or until the inadequacy of natural selection acting on undirected mutation, as established by experiment, had been proved in at least one example.

Dr. R. Melville pointed out that the study of palaeobotany showed that similar stages of evolution were reached in different plant groups in the same geological period. Thus land plants began with microspores only, developed megaspores, which were then reduced to a single megaspore enclosed by the megasporangium and a cupule, in several groups of carboniferous age. These were substantially seeds, but seeds with embryos came later in angiosperms, cycadeoidea and gymnosperms. Bentham and Hooker classified modern dicotyledons according to the freedom from one another or cohesion of the floral parts and their position relative to the ovary. More recently, taxonomists have realized that these characters represent only stages in evolution reached at one time in several different lineages. Such general trends in evolution seemed to be more readily explicable on Lamarckian rather than Mendelian lines.

Dr. Edward Hindle remarked that the views put forward in such an eloquent manner by Prof. Wood Jones were unsupported by any undoubted example of directed mutation. With regard to the head-louse and body-louse, they had been shown to be merely varieties of one species, *Pediculus humanus*, and it was unnecessary to assume that the characteristics of the body-louse were a direct response to the wearing of clothes.

The lecturer referred to the lack of any satisfactory explanation of the inheritance of the main features of a living being, and stated that genetical results were based on the study of minor characters, but surely it was more reasonable to approach such a difficult subject by an investigation of the genetics of individual characteristics rather than that of the complex mixture of characters found in any particular animal or plant. In his opinion it would be just as reasonable to expect a chemist to begin the study of his subject by an investigation of serum-proteins or similar complex molecules. The importance of the time-factor, which had been

so strongly emphasized, should be viewed with a certain degree of caution, for there were examples of animals which had changed very little since palaeozoic times, whilst in the laboratory new varieties (incipient new species) were continually appearing. The majority of the different breeds of dogs were of very recent origin, and although generally inter-fertile, they presented marked structural differences, and if occurring in nature would certainly be regarded as distinct species.

Finally, Dr. Hindle stated that he saw no reason to adopt the Lamarckian theory of inheritance until more satisfactory evidence was available.

Dr. M. J. D. White said that he thought Prof. Wood Jones had gone too far in asserting that cytoplasmic inheritance was an important factor in animal evolution. Although a considerable number of cases of cytoplasmic inheritance were now known in plants, in the Metazoa this type of heredity seemed to be almost completely non-existent. In the Protozoa, on the other hand, the recent work of Sonneborn on the 'killer' reaction in *Paramecium* suggested that specific cytoplasmic determinant might constitute an important part of the hereditary mechanism. Perhaps such a system of cytoplasmic determinants was mechanically incompatible with the complex histological differentiation which takes place during the development of every Metazoan. If so the evolutionary step from unicellularity to multicellularity may have taken place in a group of Protozoa in which the importance of the cytoplasmic determinants had become very slight, and was only possible under those conditions.

Prof. Wood Jones also appeared to think that specific characters were those that appeared late in ontogeny. In insects, at any rate, many instances were known in which it was easier to distinguish species in the larval stage : the mosquitoes of the *Anopheles maculipennis* group of species were a well-known example of this state of affairs.

Dr. Ursula Philip. There are a number of examples where a perfectly valid new species has been formed by means based on chromosome mechanics ; for instance, *Primula kewensis*, which arose from a cross between *P. floribunda* and *P. verticillata* with subsequent doubling of chromosome numbers. No other extra nuclear mechanisms had to be invoked to explain the facts.

Dr. Maria Skalińska. Studies of polyploids occurring in nature show that these types have a wider distribution than their putative ancestors ; they are able to grow in a variety of ecological conditions whereas the related diploids or lower polyploids are restricted to particular habitats (e.g., desert plants with diploid and polyploid forms investigated by Hagerup, 1932, diploid and tetraploid species and races of *Tradescantia*, Anderson and Sax, 1936, as well as tetraploid and octoploid types of *Valeriana officinalis*, studied by myself). Polyploidy brings about morphological and physiological changes which increase the adaptability of the presumably younger types and enable them to advance into new habitats. The respective changes are achieved suddenly, owing to mutation or hybridization. Recent investigations in cyto-genetics and cyto-ecology have thrown light on the origin of polyploidy and have shown the invalidity of the Lamarckian theory and of the time factor for explaining the origin of these adaptations.

Prof. Wood Jones in replying to *Prof. Haldane* disclaimed any suggestion that he had attempted to locate the factors that constituted the 'main differences between species' in the general cytoplasm. On the other hand, it was these specific characters that he had postulated as being nuclear and chromosomic. The difficult question of the characters and inheritance in the sexless workers of insect communities was no more easily resolved by an appeal to Mendelian than to Lamarckian conceptions. *Dr. Mather* was mistaken in his statement that the speaker had claimed that geneticists had concerned themselves only with nuclear heredity to the exclusion of consideration of the cytoplasm, for he had especially called attention to the work of both the older and the more recent investigators of cytoplasmic inheritance. In his remarks on human pediculi *Dr. Edward Hindle* had in reality confirmed and amplified the statement of the speaker, for should the two forms, the Head Louse and the Body Louse, be regarded as merely varieties and not as subspecies, the time table for the natural production of a subspecies must be correspondingly prolonged. That larvae or embryonic phases are more distinct from each other than are the imaginal or adult forms might, in general, be considered as evidence of convergent evolution and in certain cases it is well known to be so. Such an explanation might or might not solve *Dr. White's* problem in connection with Mosquitoes; but at any rate it could not be overlooked. *Dr. Ursula Philip* in instancing the production of two species of primulas by 'chromosome mechanics' is obviously in agreement with the speaker's claim that specific characters are created and inherited by such a mechanism.

CONTRIBUTIONS TOWARDS THE FUNGUS FLORA OF UGANDA.—VII. NEW RECORDS AND REVISIONS (*continued*)

By C. G. Hansford, M.A., F.L.S.,
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The present paper is a continuation of Contribution No. VI. of this series (Proc. Linn. Soc. Lond. 156 Sess. (1943–4), Part 2), and includes recent collections by the author in Uganda, together with a few new species resulting from his examination of the collections of Meliolaceae made by F. C. Deighton in West Africa. The consecutive numbering of the species is continued from the previous paper mentioned above.

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74. Systremma Canthii Hansf.

The description of this species, included in my paper on 'The Foliicolous Ascomycetes, Their Parasites and Associated Fungi', is expected shortly to appear as a 'Mycological Paper' issued by the Imperial Mycological Institute.

Recent collections (*Hansford 3228*, on *Canthium vulgare*, Entebbe Road, Uganda) have shown this species in its conidial stage :

Conidial stroma exactly as the perithecial, with the conidia formed on the innermost layer of the wall of loculi similar to those of the ascostroma, on short simple hyaline conidiophores ; conidia hyaline, bent fusoid with acute ends, continuous with finely granular contents, smooth, 30–37 × 1·5–2 μ, becoming pale olivaceous after discharge from the loculus, prior to germination.

75. **Dialacenium Landolphiae** Hansford, sp. n.

Plagulae hypophyllae griseo-atrae tenues, orbiculares vel in confluendo irregulares majores, leves, 2–3 mm. diam. vel effusae. *Mycelium* ex hyphis rectis vel leniter flexuosis, brunneis, 3–4 μ crassis, cellulis 20–40 μ longis, opposite vel irregulariter ramosis, laxe reticulatis compositum. *Hyphopodia* opposita vel alternata, 1-septata, 18–30 μ longa, cellula basali cylindracea vel flexuosa 5–11 μ longa, cellula apicali cylindracea plerumque sinuosa tortuosa vel uncinata, apice rotundata, 10–20 × 3–4 μ ; interdum hyphopodia in hyphas mycelii extendita. *Haustoria* in cellulis singulis dispersis epidermidis efformata, per cuticulam folii cum apicibus hyphopodiorum connexa, tenuiter patelliformia granulosa, parietem superiorem cellulae folii adhaerentia. *Pycnidia* laxe dispersa superficialia atra globosa, in sicco cupulato-collapsa, 80–150 μ diam., superne setosa ; setae radiantes vel reflexae, usque ad 150 μ longae, rectae vel flexuosae, atro-brunneae superne pallidiores, simplices, septatae, 3–4 μ crassae, apicem versus cuticulam folii adhaerentes et hyphis mycelii intermixtae. *Paries pycnidii* unistratosus atro-brunneus ex cellulis anguloso-rotundatis 6–10 μ diam. compositus, extus dense atrogranulosus, semi-opacus, apice poro rotundato 20 μ diam. pertusus, membranaceus, haud mucoso-diffluens. *Conidia* hyalina, cylindracea vel elongato-ellipsoidea, utrinque rotundata, levia, 1-septata haud constricta, 18–26 × 4·5–6 μ, in germinatione fuscescentia. *Perithecia* rara, inter pycnidia sparsa, obconica, pallide- vel atrobrunnea, levia, 80–130 μ diam. et circa 50 μ alta, glabra, in maturitate subdiscoidea, gelatinosa ; paries perithecii unistratosus ex cellulis 5–8 μ diam. compositus, in maturitate superne pallescens et cellulis disjicientibus in muco hyalino natantibus. *Asci* aparaphysati basales numerosi, usque ad 40, in ordine maturescentes, sessiles vel subsessiles, ovati vel late ellipsoidei vel clavati, 4–8-spori, in maturitate circa 40 × 20 μ. *Sporae* 2–3-seriatae, oblongae utrinque rotundatae, dilute brunneae, leves, 1-septatae leniter constrictae, 21–24 × 8–9 μ, cellulis aequilongis sed illis superioribus leniter crassioribus.

Hab. in foliis *Landolphiae ugandensis*, Kisubi, Entebbe Road, Uganda, *Hansford 3226* (typus), *3272*.

This fungus is remarkable in that the pycnidia are not mucose-diffluent and resemble those of many Sphaeriaceae ; the perithecia are rarely formed. Many hyphopodia form two head cells as branches from a single stalk cell, and occasionally the head cell grows out into an ordinary hypha of the mycelium. The pycnidial setae are reflexed on to the leaf surface and sometimes form a hyphopodium at the apex, or more rarely grow out into mycelial hyphae. The perithecia are at first parenchymatous in structure, but soon the wall cells become pale and separate to float on the mass of hyaline mucus developed inside the perithecium, which at full maturity is subdiscoid in shape.

76. **Meliola asclepiadacearum** Hansford, sp. n. (*3111.4222.*)

Plagulae epiphyllae densae atrae subvelutinae orbiculares, usque ad 5 mm. diam., interdum in maculam purpuream insidentes. *Mycelium* ex hyphis atrobrunneis subrectis vel leniter flexuosis 7–8 μ crassis (cellulis circa 25 μ longis) opposite ramosis, dense reticulatis compositum. *Hyphopodia capitata* alternata, 20–30 μ longa, recta vel antrorse directa ; cellula basali cylindracea 5–12 μ longa, cellula apicali integra, ovata vel clavata 15–19 × 9–12 μ. *Hyphodia mucronata* pauca, dispersa, ampullacea, recta vel curvata, opposita vel alternata, 15–22 × 7–10 μ, superne in collum tenue attenuata. *Setae mycoliales* numerosae, dispersae, erectae, rectae, simplices, obtusae, usque ad 330 μ longae, basi 7–9 μ crassae. *Perithecia* dispersa, globosa, atra, verrucosa, glabra, usque ad 170 μ diam. *Sporae* atrobrunneae, cylindraceae vel anguste ellipsoideae utrinque obtuse rotundatae, 4-septatae, constrictae, leves 45–49 × 15–18 μ vel curvulae.

Hab. in foliis *Cynanchi abyssinici* var. *tomentosi*, Semuto Road, Uganda, *Hansford 3337.*

77. **Meliola Canthii** Hansford, sp. n. (*3111.5222.*)

Plagulae epiphyllae vel interdum amphigenae vel caulicolae, atrae velutinae densae subcrustosae, usque ad 3 mm. diam., in confluendo multo majores et irregulares. *Mycelium* ex hyphis atrobrunneis, leniter sinuosis, 8–9 μ crassis (cellulis 25–40 μ longis) opposite acute ramosis, dense reticulatis compositum. *Hyphopodia capitata* alternata, distantia, antrorse curvata 24–30 μ longa, cellula basali cylindracea curvata 7–11 μ longa, cellula apicali cylindraceo-clavata vel sinuoso-sublobata, 15–21 × 12–17 μ. *Hyphopodia mucronata* opposita vel alterna, dispersa, ampullacea 18–20 μ longa, basi 7–9 μ crassa. *Setae mycoliales* numerosae atrae erectae rectae simplices, apice acutae vel subacutae 240–350 μ longae, basi 7–9 μ crassae. *Perithecia* dispersa atra globosa verrucosa glabra 120–190 μ diam. *Sporae* atrobrunneae, cylindraceae utrinque rotundatae, 4-septatae, constrictae, leves 43–52 × 13–15 μ.

Hab. in foliis *Canthii vulgaris*, Entebbe Road, Uganda, *Hansford 2300* (typus), *2862*, *1912* ; in foliis *Mitragynis stipulosae*, *Hansford 2951.*

In Journ. Linn. Soc. Bot. LI, p. 284, 1937, this species was given as *M. Woodiana* Sacc. ex Syd., but comparison with South African specimens of the latter show that it is easily distinguished from *M. Canthii* by its broadly curved to reflexed mycelial setae.

78. **Meliola Canthii** Hansf. var. **aristata** (Hansf.), comb. n.

Syn. *Meliola Woodiana* Sacc. ex Syd., var. *aristata* Hansf. in Journ. Linn. Soc. Bot., LI, p. 284, 1937.

This variety is removed from *M. Woodiana* on account of its straight mycelial setae.

79 **Meliola Gouaniae** Hansford, sp. n.

Plagulae epiphyllae tenuissimae orbiculares atrae, usque ad 4 mm. diam., laxe dispersae. *Mycelium* ex hyphis subrectis vel leniter sinuosis, dilute brunneis 5–6 μ crassis (cellulis plerumque 25–30 μ longis) opposite ramosis, laxe reticulatis compositum. *Hyphopodia capitata* plerumque alternata interdum etiam opposita, suberecta, 8–17 μ longa, cellula basali

cylindracea 2–5 μ longa, cellula apicali subglobosa 8–10 × 7–9 μ rarius cylindracea (—14 μ longa), integra. *Hyphopodia mucronata* opposita vel alternata, interdum numerosa, ampullacea, usque ad 25 × 6 μ. *Setae myceliales* plerumque juxta perithecia evolutae, rectae atrae erectae simplices obtusae, usque ad 200 μ longae, basi 7–8 μ crassae, apicem versus subtorulosae. *Perithecia* dispersa, atra globosa verrucosa glabra, usque ad 1050 μ diam. *Sporae* atrobrunneae cylindraceae utrinque rotundatae, 4-septatae constrictae leves 28–33 × 11–12 μ.

Hab. in foliis *Gouaniae longispicatae*, Semuto Road, Uganda, *Hansford 3318*.

The subtorulose mycelial setae might be mistaken for the conidiophores of a parasitic *Helminthosporium*, but are present in unparasitized colonies and have been traced to their origin from the *Meliola* hyphae. The fungus occurs mixed with the colonies of *Irenopsis tenuissima* (Stev.) Stev. from which it is easily distinguished by mycelial characters as well as the presence of mycelial setae and glabrous perithecia.

80. **Meliola landolphiicola** Hansford, sp. n. (*3111.4223.*)

Plagulae amphigenae plerumque epiphyllae, atrae, orbiculares 2–6 mm. diam., saepe numerosae, tenues vel subdensae, in maturitate subvelutinae. *Mycelium* ex hyphis atrobrunneis sinuosis 7–9 μ crassis (cellulis plerumque 20–30 μ longis) opposite vel irregulariter ramosis, dense reticulatis et intertextis compositum. *Hyphopodia capitata* alternata 22–28 μ longa, antrorsa, cellula basali cylindracea, recta vel curvula, 5–10 μ longa, cellula apicali cylindracea vel clavata, plerumque plus minusve irregulari vel sublobata, recta vel saepius curvata vel sinuosa, 14–20 × 9–16 μ. *Hyphopodia mucronata* dispersa opposita ampullacea, in collum curvatum elongatum attenuata. *Setae myceliales* paucae vel numerosae, erectae rectae, subopace atrae, simplices obtusae 400–600 μ longae, basi 8–10 μ crassae. *Perithecia* laxe dispersa, atra globosa glabra verrucosa, usque ad 180 μ diam. *Sporae* atrobrunneae cylindraceae utrinque rotundatae, 4-septatae constrictae leves 39–44 × 16–19 μ.

Hab. in foliis *Landolphiae ugandensis*, Entebbe Road, Uganda, *Hansford 3226*.

81. **Meliola macarangicola** Hansford, sp. n. (*3113.6322.*)

Plagulae hypophyllae atrae orbiculares densae velutinae, usque ad 8 mm. diam. *Mycelium* ex hyphis atrobrunneis sinuosissimis vel flexuosis, saepe geniculatis, 6–9 μ crassis (cellulis plerumque 23–35 μ longis) opposite vel irregulariter ramosis, densissime reticulatis et in centro plagularum subsolide aggregatis compositum. *Hyphopodia capitata* opposita vel alternata, diversiformia, 25–45 μ longa, cellula basali cylindracea flexuosa vel tortuosa, 9–25 μ longa, cellula apicali clavata truncata vel saepius irregulari, interdum sublobata, 14–25 × 12–19 μ. *Hyphopodia mucronata* pauca, dispersa, irregulariter ampullacea, in collum curvatum breve attenuata. *Setae myceliales* numerosae erectae rigidae atrae opacae simplices acutae, usque ad 320 μ longae, basi 7–9 μ crassae. *Perithecia* dense dispersa, globosa atra verrucosa glabra, usque ad 190 μ diam. *Sporae* atrobrunneae ellipsoideae utrinque rotundatae, 4-septatae constrictae leves, 59–68 × 19–25 μ.

Hab. in foliis *Macarangae Schweinfurthii*, Mityana, Uganda, *Hansford 3217*.

82. **Meliola uvariicola** Hansford, sp. n. (*3213.4321.*)

Plagulae epiphyllae atrae densae suberustosae 1–2 mm. diam., rarius etiam hypophyllae. *Mycelium* ex hyphis atrobrunneis subrectis 8–9 μ crassis (cellulis plerumque 20–25 μ longis) opposite subrectangulariter ramosis, dense reticulatis compositum. *Hyphopodia capitata* plerumque alternata etiam opposita, 16–27 μ longa, suberecta, cellula basali cylindracea 3–10 μ longa, cellula apicali cylindracea superne rotundata, plerumque recta, 10–15 × 8–12 μ. *Hyphopodia mucronata* dispersa, opposita vel alternata, ampullacea vel subconoidea 18–24 μ longa. *Setae myceliales* paucae vel numerosae praecipue juxta perithecia evolutae, erectae atrae simplices obtusae, usque ad 180 μ longae et basi 10–12 μ crassae, apicem versus tortuosae vel dense circinatae. *Perithecia* in centro plagularum dense 2–6-aggregata, globosa atra verrucosa glabra, usque ad 210 μ diam. *Sporae* atrobrunneae cylindraceae vel leniter ellipsoideae utrinque rotundatae, 4-septatae, constrictae leves 41–47 × 15–18 μ.

Hab. in foliis *Uvariae bukobensis*, Entebbe Road, Uganda, *Hansford 3286* (typus) ; Dwoli, Hoima, Uganda, *Hansford 2674*.

The mycelial setae in the latter specimen are less coiled than in the type, but in other characters the two specimens agree closely.

83. **Phaeodimeriella echinulospora** Hansford, sp. n.

Mycelium ex hyphis dilute olivaceis 2–3 μ crassis, irregulariter ramosis, exhyphopodiatis flexuosis, indistincte septatis compositum, in plagulis *Englerulae* parasitans. *Perithecia* laxe dispersa, atra, globosa vel ovata, usque ad 160 μ diam. ; paries subopace atrobrunneus subdurus fragilis 1–2-stratosus, ex cellulis angulosis 8–12 μ diam. compositus, intus etiam stratum unum cellulis hyalinis, apice poro rotundato 15–20 μ diam., saepe leniter papillato pertusus ; sursum setis 6–20 dispersis erectis vel patentibus, simplicibus obtusis atrobrunneis, subrectis vel uncinatis, indistincte 1–2-septatis, leniter, undulato-verrucosis, usque ad 110 × 4–6 μ praeditus. *Asci* indistincte paraphysati, basales cylindraceo-clavati subsessiles, sursum rotundati, 8-spori 70 × 14 μ. *Sporae* oblique 2–3-seriatae atrobrunneae, oblongae vel clavulatae utrinque rotundatae, 1-septatae, leniter constrictae 16–20 × 5–7·5 μ cellula superiore leniter crassiore, episporio subtiliter distincta echinulato-scabrido ; sporae raro 0 vel 3-septatae.

Pycnidia (*Cicinnobella* sp.) peritheciis consimilia sed leniter minora, usque ad 100 μ diam., glabra vel setosa, membranacea ; conidia anguste ellipsoidea vel fusoidea utrinque rotundata, dilute brunnea vel flavido-olivacea, levia continua 6–9 × 1–2 μ.

Hab. in plagulis *Englerulae Macarangae* P. Henn. in foliis *Macarangae Schweinfurthii*, Mityana, Uganda, *Hansford 3217 p.p.*

In texture the perithecia are rather darker and more brittle than in other species of the genus, though the pycnidia are normal ; the occurrence of occasional 3-septate ascospores is not considered sufficient to remove it from *Phaeodimeriella*.

84. **Aphanostigme Annonae** Hansford, sp. n.

Mycelium ex hyphis subhyalinis angustis compositum, in tomento folii parasitans, per stomata folii dubie penetrans. *Perithecia* hypophylla in areas indistinctas emarginatas tomenti folii laxe dispersa, superficialia inter pilos folii singulariter laxeque dispersa, atra subglobosa 140–180 μ diam., leniter papillata et apice poro rotundato 20–25 μ diam. pertusa ; paries perithecii extus hyphis brevibus, obscure rufo-brunneis, dense reticulato-agglutinatis vestitus, ex strato uno cellularum angulosarum parenchymatico compositus, 5–10 μ crassus, lentus membranaceus, sursum setis 15–30 erectis vel patentibus, continuis atrobrunneis simplicibus, rectis vel leniter flexuosis, obtusis 20–100 × 3–4 μ praeditus. *Asci* numerosissimi basales cylindracei, sursum rotundati, deorsum in stipite contracti, recti vel curvuli, 8-spori, circa 70 × 7 μ. *Sporae* oblique 2-seriatae, fusoideae rectae hyalinae utrinque subacutae, 3-septatae haud constrictae leves 12–15 × 2·5–3·5 μ, clavulatae. *Paraphyses* numerosae hyalinae filiformes ramosae, indistincte septatae.

Hab. in foliis *Annonae senegalensis*, Semuto Road, Uganda, *Hansford 3311.*

85. **Aphanostigme Flabellariae** Hansford, sp. n.

Mycelium ex hyphis subhyalinis vel dilute olivaceis, exhyphopodiatis 2–3 μ crassis, septatis compositum, in pilis folii parasitans. *Perithecia* hypophylla, inter pilos folii laxe dispersa, atra globosa superficialia, usque ad 120 μ diam. ; paries perithecii unistratosus, ex cellulis obscure rufo-brunneis angulosis 5–7 μ diam., et strato uno hyalino cellularum compressarum compositus, apice poro rotundato vel irregulari pertusus, extus hyphis brevibus intricatis atrobrunneis vestitus, sursum hyphis erecto-divergentibus, usque ad 40 × 3–4 μ, obtusis flexuosis simplicibus praeditus. *Asci* numerosissimi erecti cylindracei, sursum rotundati, deorsum subsessiles vel in stipitem brevem contracti, 8-spori, 60–75 × 7–9 μ. *Sporae* oblique 2–3-seriatae, hyalinae fusoideae utrinque subacutae, 3–5-septatae, haud constrictae leves 16–20 × 4–5 μ. *Paraphyses* numerosae filiformes simplices 1 μ crassae.

Hab. in foliis *Flabellariae paniculatae*, Entebbe Road, Uganda, *Hansford 3280.*

86. **Phaeophragmeriella Englerulae** Hansford, sp. n.

Mycelium in plagulis *Englerulae Macarangae* parasitans, ex hyphis exhyphopodiatis dilute olivaceis 2–3 μ crassis, indistincte septatis, flexuosis, irregulariter ramosis, dense reticulatis compositum. *Perithecia* irregulariter laxeque dispersa, superficialia, globosa vel ovata, 80–120 μ diam., atra membranacea setosa ; paries perithecii hyphis brevibus, dense intricatis, atro-olivaceis vestitus, ex strato uno atro-olivaceo uno hyalino compositus, 5–8 μ crassus, sursum setis dispersis 10–20 erecto-divergentibus dilute olivaceis, apicem versus subhyalinis, rectis vel leniter flexuosis, simplicibus, usque ad 60 μ longus, basi 3·5–5 μ crassis, sursum attenuatis apice acutis praeditus. *Asci* basales ellipsoidei, plus minusve curvati, apice attenuato-rotundati, deorsum attenuati breviter stipitati, 8-spori, 70–75 × 14–18 μ. *Sporae* parallelae elongato-clavulatae, dilute viridi-olivaceae, 5–7-septatae, haud constrictae, leves 50–60 μ longae, apice rotundatae, 4·5–5 μ cr., basim versus attenuatae (– 2 μ), basi subacutae.

Hab. in plagulis *Englerulae Macarangae* P. Henn., in foliis *Macarangae Schweinfurthii*, Mityana, Uganda, *Hansford 3217 p.p.*

This species is more definitely setose, with paler setae than others in the genus and no conidial stage was found associated with it in this collection.

87. **Nematothecium Asterinae** Hansf., sp. n.

Mycelium in plagulis *Asterinae* parasitans, ex hyphis hyalinis vel subhyalinis, 2 μ crassis, dense pelliculoso-reticulatis, indistincte septatis, exhyphopodiatis compositum. *Perithecia* dispersa, depresso-globosa, atra, usque ad 60 μ diam. et 30–40 μ alt., glabra; paries indistincte pseudoparenchymaticus, ex hyphis meandricis subgelatinosis agglutinatis compositus, unistratosus, purpureo- vel brunneo-ater, vertice irregulariter apertus demum late apertus et stratum paraphysarum detegens. *Asci* numerosissimi, erecti, ellipsoidei vel clavati, sursum rotundati, deorsum leniter attenuati, subsessiles, 8-spori, 18–23 × 4–7 μ. *Sporae* filiformes, parallelae, continuae hyalinae rectae, 16–20 × 1 μ. *Paraphyses* primo numerosae, demum plus minusve evanescentes, hyalinae, filiformes, simplices, usque ad 30 × 1 μ.

Pycnidia peritheciis consimilia; pycnosporae filiformes, continuae, hyalinae, 4–10 × 1 μ.

Hab. in thyrotheciis *Asterinae geniospori* in foliis *Geniospori paludosi*, Bombo Road, Uganda, *Hansford 1795* (typus); in plagulis *Balladynae* spec., Kabale, Uganda, *Hansford 2158*; in plagulis *Asterolibertiae* spec., *Hansford 3296*.

88. **Saccardomyces atropurpureus** Hansford, sp. n.

Perithecia densissime aggregata vel connata, atra opaca obconica circa 50 μ diam., saepius in ascomatibus compositis connata, usque ad 200 μ diam. et 30–40 μ alt., irregularibus: paries perithecii primo ex cellulis opace purpureo-nigris compositus, unistratosus, mox mucoso-diffluens. *Asci* numerosi erecto-divergentes cylindraceo-clavati aparaphysati, in ordine maturescentes et collabascentes, 25 × 6–7 μ, apice rotundati vel subtruncati, subsessiles 8-spori. *Sporae* oblique 2–3-seriatae, cylindraceae utrinque rotundatae rectae vel curvulae, leves continuae 5–6 × 1·5–2 μ, hyalinae vel saepius ex pariete perithecii purpureo-sordidae.

Hab. in plagulis *Meliolae ramicolae* Hansf. in foliis *Uvariae Welwitschii*, Entebbe Road, Uganda, *Hansford 3297*.

This species is very close to *S. microspora* Hansf., from which it differs chiefly in its purple-black colour; the purple dye of the perithecial wall is soluble in lacto-phenol and in glycerin; usually as the wall degenerates into structureless mucus surrounding the group of asci, the dye penetrates asci and spores to stain these a dirty purple-brown and rendering it very difficult to observe the structure of all parts of the fungus. The collapsed asci much resemble broad paraphyses, but in young perithecia no paraphyses were found.

89. **Malacaria entebbeensis** Hansford, sp. n.

Mycelium in plagulis *Meliolae* parasitans, ex hyphis hyalinis vel flavidis, 2 μ crassis, indistincte septatis, ramosis, dense reticulatis compositum. *Perithecia* laxe vel subdense dispersa, rufo-brunnea vel atro-

brunnea, 180–240 μ diam., subglobosa, setosa ; paries perithecii obscure rufobrunneus, extus hyphis aliis brevibus, dense intertextis, 5–7 μ crassis vestitus, hyphis aliis setiformibus erectis dilutioribus, usque ad 50×4–6 μ, simplicibus obtusis praeditus, paries ipse ex strato uno rufobrunneo cellularum angulosarum 4–7 μ diam., et strato uno interiore hyalino compresso compositus, apice poro rotundato 15 μ diam. pertusus. *Asci* numerosissimi cylindracei, apice rotundati, deorsum nodoso-stipitati 8-spori 40–47×8–10 μ. *Sporae* parallelae, olivaceae, cylindracco-filiformes, apice rotundatae, deorsum leniter attenuatae, basi subacutae, 5-septatae, haud constrictae, leves 30–37×3 μ. *Paraphyses* numerosae hyalinae filiformes simplices 1 μ crassae.

Hab. in plagulis *Meliolae Artabotrydis* Hansf. in foliis *Artabotrydis nitidi*, Entebbe Road, Uganda, *Hansford 3243*.

90. CHAETOTHYRIUM sp.

On *Ficus variifolia*, Entebbe Road, Uganda, *Hansford 3261*.

Colonies epiphyllous effuse black, thin to fairly dense, with loosely scattered perithecia and usually mixed with *Microxyphium* pycnidia and *Capnodium* sp., associated with scale insects. Mycelium of pale brown exhyphopodiate hyphae, completely superficial and easily detached, some hyphae with barrel-shaped cells, constricted at the septa, 8–15× 6–9 μ, passing into narrower straighter hyphae, slightly paler, 3–5 μ wide, with cells 10–50 μ long. These hyphae all belong to the same mycelium, with thin smooth walls, pale olivaceous to subhyaline, much branched in an irregular manner, closely reticulate, exhyphopodiate. Mycelial setae none. Perithecia loosely scattered, globose to slightly papillate or ovate, 80–120 μ diam. black, sitting on a broad base, thinly membranous ; wall apparently of a single layer of rather large pale olivaceous parenchyma continuous at the base with the mycelial hyphae, the cells rounded-angular 6–10 μ diam. ; on the upper half with numerous erect-spreading darker setae up to 80×3·5–5 μ, simple, obtuse, indistinctly septate, dark brown, paler towards the apex ; pore indistinct irregular, about 20 μ diam. Asci basal, aparaphysate, numerous, clavate-ellipsoid, subsessile or nodose stipitate, 8-spored, 70×20 μ. Spores obliquely 2–3-seriate, fusoid with rounded ends, more or less bent, hyaline, smooth, 3-septate, not or very slightly constricted, 24–30×5·5–7 μ.

91. **Entopeltis Craterispermi** Hansford, sp. n.

Plagulae epiphyllae, nigrae, rotundatae vel irregulares usque ad 2 mm. diam., laxe irregulariterque dispersae, leves, nitentes, interdum amphigenae. *Mycelium* ex hyphis dilute olivaceis, sinuosis, vel flexuosis, radiantibus, irregulariter denseque ramosis, exhyphopodiatis 5–8 μ cr., cellulis 5–10 μ long. compositum, in centro plagularum subsolidum, septis hypharum atro-brunneis. Sub plagulam totam cellulae epidermidis folii omnes granulis atro-olivaceis referciuntur. *Thyriothecia* in centro plagularum dense aggregata, orbiculata atra, usque ad 150 μ diam., dimidiata, in centro usque at 70 μ alt. et poro rotundato vel irregulari pertusa ; paries inferior atro-olivaceus, ex hyphis meandricis 2–3 μ crassis exhyphopodiatis septatis unistratosis, ad cuticulam folii fortiter adhaerentibus compositus ; paries superior opace atrobrunneus, ex hyphis indistincte radiantibus, 5–7 μ crassis unistratosis compositus, margine in mycelium transiens.

Asci numerosi basales, porum thyriothecii versus directi, late clavati, sessiles vel subsessiles, 8-spori, evanescentes, 45–50 × 11–14 μ. *Sporae* 2-3-seriatae, ellipsoideae vel oblongae, apice rotundatae, basi minute papillatae, atrobrunneae, supra medium zono subhyalino praeditae, leves continuae 12–14 × 5–7 μ. *Paraphyses* numerosae filiformes hyalinae simplices vel furcatae, apice clavulatae, 1 μ crassae.

Hab. in foliis *Craterispermi laurini*, Entebbe Road, Uganda, *Hansford 3225 p.p.*

The fungus forms small rounded black shining colonies scattered loosely over the upper surface of the leaf and occasionally on the lower surface. The mycelium consists of rather wide hyphae, very pale olivaceous with numerous much darker and rather thick septa, closely and irregularly branched and towards the centre forming a solid plate. At the edges of the colony the hyphae are definitely above the cuticle, though closely adherent, but part of the cuticle appears to be dissolved by their action and to be deposited as a thin film over the centre of the colony, which is not detached from the leaf in collodion or cellulose acetate films. All the epidermal cells below the whole colony are filled with dark olivaceous-black granular matter in which the haustoria are embedded, often several in a single cell and each connected to the mycelium by a fine filament direct through the remains of the cuticle.

92. Stigmatea Cremasporae Hansford, sp. n.

Plagulae epiphyllae minutae atrae nitentes, usque ad 1 mm. diam. *Mycelium* ex hyphis dilute olivaceis, exhyphopodiatis 7–10 μ crassis, cellulis 4–8 μ longis, irregulariter denseque ramosis, rectis vel flexuosis compositum, in centro plagularum solidum, septis hypharum crassis atrobrunneis. *Thyriothecia* in centro plagularum 2–5-aggregata rotundata dimidiata atra 120–160 μ diam. 40–50 μ alt.; paries inferior subhyalinus pseudoparenchymaticus; paries superior subopace atrobrunneus, ex hyphis irregulariter radiantibus, unistratosis compositus, poro rotundato centrali 10 μ diam. pertusus, extus nitens. *Asci* basales, porum versus directi, numerosi, ellipsoidei vel subovati, subsessiles vel nodoso-stipitati 30–35 × 15–19 μ, 8-spori. *Sporae* multiseriatae vel conglobatae, brunneae oblongae, apice obtuse rotundatae vel in juventute leniter invaginatae et planae, deorsum leniter attenuatae, 1-septatae, lenissime constrictae, leves, cellula superiore 9–12 × 4·5–5 μ, cellula inferiore subpapillata hemisphaerica 2 μ diam.

Hab. in foliis *Cremasporae africanae*, Entebbe Road, *Hansford 3273.*

The mycelium and habit of this fungi is identical with that of *Entopeltis Craterispermi* above, but it differs in the clearly 1-septate spores, which are of uniform brown colour without a hyaline band.

93. Cocconia Connari Hansford, sp. n.

Ascomata amphigena plerumque epiphylla, irregulariter laxeque dispersa, raro confluentia, orbicularia vel irregularia usque, ad 5 mm. diam. et 80–120 μ alt., atra rugulosa. *Hypostroma* in epidermide et subepidermide dispositum, sub ascostromate toto continuum et cum eodem pluries connexum, pseudoparenchymaticum, densum, atrobrunneum, ex cellulis 5–8 μ diam. compositum, hyphis pallidioribus inter cellulas paliformes mesophyllas penetrantibus, haustoriis nullis. *Paries*

inferior ascostromatis ex hyphis atrobrunneis, irregulariter radiantibus et intertextis compositus, cellulis 4–7 μ diam., usque ad 10 μ crassus, intus hyalinus passusque. *Paries superior* circa 10 μ cr., ex hyphis radiantibus, opace atrobrunneis compositus, cellulis 2–3-stratosis circa 10 × 6 μ. *Loculi* irregulariter interrupteque plurie-circinatim circam medium sterilem dispositi, quisque 50–100 μ lat., longitudinaliter apertus, pariete superiore in medio disrumpenti et in muco interiore natanti, marginem versus erecto et hymenium detectum circumvenienti. *Asci* numerosi erecti ellipsoidei apice rotundati, deorsum sessiles vel breviter stipitati, 8-spori 50–60 × 12–15 μ. *Paraphyses* hyalinae filiformes continuae 1 μ cr. *Sporae* oblique 1–2-seriatae, clavulatae hyalinae, in maturitate dilute brunnescentes, leves, 1-septatae, leniter constrictae, cellula superiore leniter crassiore brevioreque, 13–15 × 6–7 μ.

Hab. in foliis *Connari longistipitati*, Mukono, Kiagwe, Uganda, *Hansford 3209*.

The ascostromata form rounded black crusts up to 5 mm. diam. on both surfaces of the leaf, loosely scattered, concentrically rugulose over the loculi which are arranged in several broken irregular rings around the sterile centre. The hypostroma is connected at many points directly through the cuticle with the ascostroma and forms a continuous sheet in the epidermis and subepidermis beneath the whole external stroma, but extending little beyond it ; it consists of dark olive-brown cells 5–8 μ diam., becoming paler and passing into shortly septate hyphae between the cells of the palisade layer of the leaf, not forming haustoria in any cells of the host. The mature loculus is longitudinally dehiscent with the central part of the upper wall breaking up into small fragments floating on the mucus formed inside, while the remainder of the upper wall becomes erect and surrounds the exposed layer of asci and paraphyses.

94. Aulographum sp.

On leaves of *Pseudospondias microcarpa*, Mityana, Uganda, *Hansford 3222 p.p.*

Colonies hypophyllous grey, very thin, smooth, irregular up to 10 mm. diam. or often confluent and larger. Mycelium of very pale brown to subhyaline hyphae 2 μ wide, the main hyphae from almost straight to undulate or flexuous, irregularly and very closely branched, the branches flexuous and much subdivided to form in places almost a solid pellicle of hyphae ; all hyphae indistinctly septate, exhyphopodiate, apparently completely superficial. Setae none. Thyriothecia scattered, black, elongate elliptic or X- or Y-shaped, up to 800 μ or more long by 60–100 μ wide ; lower wall hyaline, of much branched sinuous-tortuous hyphae, very indistinct ; upper wall of dark brown radiate hyphae 3–4 μ wide, the cells 4–8 μ long, in the centre subopaque black-brown, more translucent towards the edge ; margin crenate or shortly fimbriate and merging into the mycelium ; dehiscence by an irregularly longitudinal fissure, becoming widely open and exposing the asci beneath a greenish layer of mucus probably derived from paraphysoids. Asci very numerous, erect, clavate to widely elliptic or ovate, subsessile or with a very short nodose stipe, broadly rounded above, thin-walled, 8-spored 25–38 × 13–18 μ, apparently aparaphysate when mature. Spores more or less parallel,

multiseriate, hyaline, oblong with rounded ends, 1-septate, not or very slightly constricted, smooth, 10–13 × 4–5 μ, the cells subequal.

Pycnidia numerous, scattered irregularly, circular, flattened conoid, of structure similar to that of the thyriothecia but lighter in colour, up to 80 μ diam. ; dehiscence by irregular central pore with more or less extensive stellate fissures towards the margin ; pycnospores hyaline, fusoid to cylindric with rounded ends, 6–9 × 1·5–2 μ, continuous.

In view of the increasing number of hosts in Uganda on which species of this genus have been discovered, and especially in view of their completely superficial habit, it seems unwise for the present to describe them as separate species, until the accumulation of many more collections and their detailed comparison renders it more certain that separate species are in fact present, as contrasted with one or more rather variable species each having a wide host range.

95. **Asterinella Pseudospondiadis** Hansford, sp. n.

Plagulae tenues irregulares griseo-atrae leves, saepe numerosae et late effusae, plerumque hypophyllae. *Mycelium* ex hyphis dilute brunneis, 2–3 μ crassis, exhyphopodiatis, irregulariter ramosis, indistincte septatis compositum, hyphis primariis subrectis vel flexuosis, secondariis tortuosis denseque reticulatis : hyphae mycelii in nodis densis dispersis irregularibus 2–3-stratosis aggregatae, cuticulam folii penetrantes et in cellulis epidermalibus haustoria minuta, globosa vel irregulariter ramosa efficientes. In cellula singula folii saepe haustoria pluria occurrunt, quaeque cum hyphis externis directe connectitur, sed hyphopodia et cellulae peculiares mycelii desunt. *Pycnidia* numerosa, irregulariter dispersa, atrobrunnea dimidiata, usque ad 110 μ diam. ; paries superior ex hyphis radiantibus 3–4 μ cr., cellulis 4–10 μ longis compositus, margine fimbriatus, hyphis fimbriarum numerosis tortuosis, usque ad 50 μ longis, interdum in crinibus lateraliter paralleleque aggregatis ; paries inferior ex hyphis indistinctis hyalinis compositus ; pycnidia stellatim fere ad marginem dehiscentia, demum late aperta. *Conidia* ellipsoidea vel irregulariter citriformia, continua atrobrunnea leves 22–37 × 14–18 μ, poris germinationibus 2 aequatorialibus, saepe unilateralibus.

Thyriothecia dispersa, orbicularia, plerumque singula 100–150 μ diam., atrobrunnea ; paries inferior indistinctus ; paries superior ex hyphis radiantibus 3–5 μ crassis, cellulis 4–10 μ longis compositus, margine fimbriatus, hyphis fimbriarum tortuosis usque ad 40 μ longis, saepe lateraliter connatis ; thyriothecia stellatim prope marginem dehiscentia et ascos detegentia. *Asci* usque ad 15, ovati vel globosi 45–50 × 40–45 μ, 8-spori aparaphysati sessiles. *Sporae* conglobatae clavulato-oblongae utrinque rotundatae, 1-septatae, fortiter constrictae, atrobrunneae 27–31 × 12–14 μ, episporio levi vel granuloso, cellula superiore globosa crassioreque, cellula inferiore 10–11 μ cr.

Hab. in foliis *Pseudospondiadis microcarpae*, Mityana, Uganda, *Hansford 3218*, typus ; Entebbe Road, *Hansford 3302*.

The exhyphodiate hyphae form small scattered knots at irregular intervals and beneath these they penetrate the leaf cuticle to form haustoria in single epidermal cells ; though several haustoria may occur in a

single host cell, each is connected directly and separately with the external hyphae, in which there are no specialized cells. The infected host cells soon become filled with disorganized granular matter in which it is difficult to distinguish the haustoria ; adjacent cells of the epidermis are unaffected.

96. **Clypeolella Craterispermi** Hansford, sp. n.

Thyriothecia epiphylla, irregulariter laxeque dispersa, pauca, plerumque in ascomatibus compositis et usque ad 800 μ diam. pluri-aggregata, thyriothecia singula orbicularia 200–250 μ diam. ; paries inferior indistinctus, ex hyphis flexuosis radiantibus hyalinis compositus ; paries superior atrobrunneus, ex hyphis radiantibus 4·5–5·5 μ cr., cellulis 10–20 μ longis compositus, margine crenatus haud fimbriatus, irregulariter stellatim dehiscens, parte centrali decidenti et hymenium mucosum detegenti. *Asci* numerosi in ordine maturescentes, aparaphysati, in muco hyalino immersi, ovati, sessiles vel subsessiles, 8-spori, circa 40 × 30 μ. *Sporae* conglobatae, oblongae utrinque rotundatae, primo hyalinae, demum dilute brunneae, 1-septatae, lenissime constrictae, leves, 18–22 × 11–13 μ, cellulis subaequalibus, saepe sporis in asco germinantibus.

Conidia = *Mitteriella Craterispermi* Hansf. (*v. supra* Contrib. No. VI, no. 62).

Hab. in foliis *Craterispermi laurini*, Entebbe Road, Uganda. *Hansford 3225 p.p.* typus, *3301, 3303.*

97. **Clypeolella Salaciae** Hansford, sp. n.

Plagulae epiphyllae griseae vel atrae, subdensae, leves, orbiculares, usque ad 5 mm. diam., saepe numerosae subconfluentes. *Mycelium* ex hyphis dilute brunneis, 5–6 μ crassis (cellulis 10–15 μ longis) opposite vel irregulariter ramosis, dense reticulatis et plagulam prope solidam efformantibus compositum. *Hyphopodia* alternata vel opposita, continua, hemisphaerica, 8–10 μ diam., integra, numerosissima.

Conidia (*Mitteriella*) pauca, dispersa, clavato-cylindracea, 3-septata, 16–19 × 8–9 μ, leniter constricta, levia, apice rotundata, cellula basali indistincta, fracta, subhyalina, aliis tribus brunneis. *Conidia* (*Sarcinella*) saepe numerosissima, ellipsoidea vel subglobosa, opace atrobrunnea, muriformia 30–35 μ diam., levia. *Thyriothecia* dispersa, orbicularia, in maturitate gelatinosa, discoidea, usque ad 240 μ diam. et 40–50 μ alt. ; paries inferior ex hyphis hyalinis flexuosis radiantibus, 4–5 μ crassis, cellulis 4–7 μ longis, compositus, subparenchymaticus ; paries superior ex hyphis dilute brunneis, radiantibus, 5–6 μ crassis, cellulis 8–10 μ longis, compositus, margine crenatus, in maturitate glebosodiffluens et hymenium gelatinosum detegens. *Asci* aparaphysati, globosi vel ovati, sessiles, 8-spori, circa 30–25 μ (immaturi). *Sporae* conglobate, oblongae utrinque rotundatae, 1-septatae leniter contrictae, leves, 20–23 × 9–11 μ, primo hyalinae, demum dilute brunneae, cellula superiore leniter crassiore.

Hab. in foliis *Salaciae* sp., Entebbe Road, Uganda, *Hansford 3262.*

The *Mitteriella* conidia described above were found only thinly scattered and all detached from the mycelium, so that it is possible they may belong to some other fungus, though only a single mycelium was detected in the colonies examined.

98. **Asterina Adeniae** Hansford, sp. n.

Plagulae epiphyllae atrae, orbiculares, usque ad 3 mm. diam., vel in confluendo effusae et multo majores, tenues leves. *Mycelium* ex hyphis brunneis flexuosis 4–5 μ crassis, cellulis 15–30 μ longis, irregulariter ramosis, laxe vel subdense reticulatis compositum, maculis retis mycelialis angulosis. *Hyphopodia* alternata continua, irregulariter 2–3-lobata vel sinuoso-lobata, 9–12 $\times$ 7–9 μ hyphis pluribus secondariis exhyphopodiatis. *Thyriothecia* dense dispersa, saepe 2–3-connata, atrobrunnea, orbicularia 80–110 μ diam.; paries inferior indistinctus; paries superior ex hyphis atrobrunneis 3·5–5 μ crassis, cellulis 6–10 μ longis, compositus, margine laxe fimbriatus, hyphis fimbriarum radiantibus, pallidioribus, exhyphopodiatis, 3·5–4·5 μ crassis, usque ad 100 μ longis, indistincte septatis, flexuosis; thyriothecia stellatim dehiscentia. *Asci* usque ad 15, aparaphysati, ovati, sessiles, 8-spori 35–40 $\times$ 22–28 μ. *Sporae* multiseriatae vel conglobatae, oblongae utrinque rotundatae, brunneae, leves, 1-septatae, constrictae, 17–19 $\times$ 8·5–9 μ, cellulis subaequalibus vel superiore lenissime crassiore. Pycnidia non visa.

Hab. in foliis *Adeniae lobatae*, Entebbe Road, Uganda, *Hansford 3252*.

99. **Asterina alchorneicola** Hansford, sp. n.

Plagulae hypophyllae, effusae, tenuissimae, aegre perspicues, griseae, leves. *Mycelium* ex hyphis sinuosissimis, dilute brunneis 2·5–3·5 μ crassis (cellulis plurumque 20–30 μ longis) irregulariter ramosis, laxe reticulatis compositum, maculis retis mycelialis sinuoso-irregularibus. *Hyphopodia* haud numerosa, dispersa, alternata vel unilateralia, 1-septata, cellula basali cylindracea 3–4 μ longa, cellula apicali recta vel subuncinata, irregulariter tenuiterque 2–3-lobata, 5–8 $\times$ 4–6 μ, hyphis pluribus secondariis exhyphopodiatis. *Thyriothecia* laxe dispersa, atra, orbicularia, 70–90 μ diam., in maturitate subglobosa; paries inferior ex hyphis subhyalinis flexuosis radiantibus compositus; paries superior ex hyphis radiantibus atrobrunneis 3–4 μ crassis, cellulis 4–7 μ longis, compositus, margine fimbriatus, hyphis fimbriarum numerosis, saepe lateraliter connatis, exhyphopodiatis, radiantibus, 3 μ cr., usque ad 50 μ longis; thyriothecia stellatim prope marginem dehiscentia, cellulis centralibus segmentorum tenuiter triangulorum deficientia et demum thyriothecia late aperata et hymenium gelatinosum detectum. *Asci* usque ad 12, in ordine maturescentes, ovati, sessiles 8-spori 25–30 $\times$ 20–25 μ, aparaphysati. *Sporae* conglobatae, oblongae utrinque rotundatae, brunneae, 1-septatae constrictae 14–17 $\times$ 8–9 μ, episporio verruculoso, cellula superiore leniter crassiore.

Pycnida thyriotheciis consimilia; pycnosporae ovatae vel piriformes, leves, continuae, brunneae, zona hyalina in medio praeditae, 13–15 $\times$ 7·5–10 μ.

Hab. in foliis *Alchorneae cordifoliae*, Entebbe Road, Uganda, *Hansford 3255*.

100. **Asterina Barteriae** Hansford, sp. n.

Plagulae epiphyllae, atrae, orbiculares, leves, usque ad 8 mm. diam., raro etiam hypophyllae. *Mycelium* ex hyphis subrectis atrobrunneis 6 μ crassis (cellulis plerumque 20–40 μ longis) opposite vel irregulariter

ramosis, dense reticulatis, compositum. *Hyphopodia* plerumque in hyphis primariis efformata, alternata vel unilateralia, recta, sinuosa vel tenuiter 2–3-sublobata, continua 8–13 × 7–13 μ ; hyphis pluribus secundariis exhyphopodiatis. *Thyriothecia* numerosa, singula vel 2–3-connata, 80–100 μ diam., raro discreta orbicularia que, in maturitate subglobosa ; paries inferior ex hyphis griseo-brunneis radiantibus 3–5 μ crassis compositus ; paries superior ex hyphis dilute brunneis radiantibus 5–8 μ crassis compositus, mox disrumpens et cellulis singularibus 6–9 μ diam. in muco natantibus, haud stellatim dehiscens, in maturitate late apertus et hymenium detergens, margine crenatus haud fimbriatus. *Asci* pauci, 3–8, in ordine maturescentes, collabascentes, globosi, sessiles, 4–8-spori, aparaphysati, in maturitate circa 50 μ diam. *Sporae* conglobatae, atrobrunneae, oblongae utrinque rotundatae, 1-septatae, constrictae, 15–18 μ, episporio subtiliter punctato-echinulato, cellula superiore lenissime crassiore. Pycnidia non visa.

Hab. in foliis *Barteriae fistulosae*, Entebbe Road, Uganda, *Hansford 3287*.

101. Asterina blanda Syd., forma.

On leaves of *Alafia lucida*, Entebbe Road, Uganda, *Hansford 3265*.

In all characters this corresponds closely to the description of the type, save that the spores are quite smooth, whereas in the type on *Motandra* sp. these are verrucose.

102. **Asterina landolphiicola** Hansford, sp. n.

Plagulae amphigenae plerumque epiphyllae, tenues, griseoatrae, leves, orbiculares, usque ad 5 mm. diam., vel in confluendo multo majores. *Mycelium* ex hyphis brunneis, sinuosis vel flexuosis, 3·5–4·5 μ crassis, cellulis 15–25 μ longis, opposite vel irregulariter ramosis, laxe vel subdense reticulatis compositum, maculis retis mycelialis angulosis. *Hyphopodia* opposita vel alternata, raro in greges 3-aggregata, subrecta, continua, digitata vel leniter sinuosa, sursum rotundata, integra vel rarius sublobata, 6–10 × 4–6 μ. *Thyriothecia* dense dispersa, discreta, orbicularia 90–130 μ diam. vel in ascomatibus irregularibus 2–3-aggregata, atrobrunnea, dimidiata ; paries inferior indistinctus ; paries superior ex hyphis atrobrunneis 3·5–5 μ crassis, cellulis 4–7 μ longis compositus, margine fimbriatus, hyphis fimbriarum pallidioribus, tortuoso-radiantibus, exhyphopodiatis, indistincte septatis, usque ad 120 μ longis ; thyriothecium stellatim prope marginem dehiscens, cellulis centralibus segmentorum late triangulorum decidentibus et hymenium gelatinosum detegentibus. *Asci* numerosi, usque ad 20, aparaphysati, ovati, sessiles, circa 30 × 25 μ, 8-spori. *Sporae* conglobatae, dilute brunneae demum atrescentes, oblongae utrinque rotundatae, leves, 1-septatae, leniter constrictae, 16–18 × 7–8·5 μ, cellulis subaequalibus, episporio tenui, levi vel subtiliter punctato-granuloso. Pycnidia non visa.

Hab. in foliis *Landolphiae ugandensis*, Entebbe Road, Uganda, *Hansford 3226 p.p.* (typus), *3272*.

At germination one cell of the spore forms a hyphopodium, while the other often collapses.

103. Asterina Urerae Hansford, sp. n.

Plagulae epiphyllae, laxe dispersae, tenuissimae, aegre perspicues, griseae, usque ad 3 mm. diam. *Mycelium* ex hyphis subrectis vel leniter flexuosis, brunneis, 4–5 μ crassis (cellulis 25–30 μ longis), opposite vel irregulariter ramosis, laxe reticulatis compositum, maculis retis mycelialis angulosis. *Hyphopodia* alternata vel opposita, 1-septata, 8–14 μ longa, antrorsa, cellula basali cylindracea 2–5 μ longa, cellula apicali cylindracea vel plerumque tenuiter 2–3-lobata, recta vel curvata, 6–9 × 6–9 μ. *Thyriothecia* irregulariter dispersa, plerumque discreta, orbiculata 80–100 μ diam., atra, dimidiata; paries inferior ex hyphis flexuoso-undulatis, radiantibus, subhyalinis compositus; paries superior ex hyphis atrobrunneis 3–4·5 μ crassis, cellulis 4–8 μ longis, radiantibus compositus, margine subfimbriatus, hyphis fimbriarum paucis, flexuoso-radiantibus, saepe lateraliter connatis, dilutioribus, exhyphopodiatis, usque ad 50 μ longis; thyriothecium stellatim dehiscens, parte centrali decidente. *Asci* aparaphysati, usque ad 15–20, in ordine maturescentes, ovati, sessiles, 4–8-spori, 30–40 × 25–30 μ. *Sporae* conglobate, oblongae utrinque rotundatae, brunneae, leves, 1-septatae, leniter constrictae 17–20 × 8–9·5 μ, cellula superiore leniter crassiore.

Pycnidia thyriotheciis consimilia; pycnosporae ellipsoideae apice rotundatae, basi truncatae, brunneae, in medio zona hyalina indistincta praeditae, leves, 10–19 × 8–9 μ, episporio circa 1 μ crasso.

Hab. in foliis *Urerae hypselodendronis*, Entebbe Road, Uganda, *Hansford 3251*.

104. Asterina uvariicola Hansford, sp. n.

Plagulae amphigenae, atrae, tenues, usque ad 3 mm. diam., vel numerosae et in confluendo multo majores. *Mycelium* ex hyphis dilute brunneis, sinuosis vel subrectis, irregulariter ramosis, laxe reticulatis, 2·5–4 μ crassis (cellulis 25–35 μ longis) compositum. *Hyphopodia* alternata, continua, pulvinata, rotundata vel 2–3-lobata, 4–6 μ alt. et 5–10 μ cr., hyphis pluribus secondariis exhyphopodiatis. *Thyriothecia* numerosa, dense dispersa, orbiculata 80–120 μ diam. vel 2–3-connata irregulariaque, atra, dimidiata; paries inferior indistinctus ex hyphis hyalinis compositus; paries superior ex hyphis radiantibus, atrobrunneis 3·5–5 μ crassis, cellulis 4–7 μ longis compositus, margine laxe fimbriatus, hyphis fimbriarum exhyphopodiatis, tortuoso-radiantibus, indistincte septatis, usque ad 100 μ longis, dilutioribus; thyriothecia stellatim in segmentibus late triangulatis dehiscentia et parte centrali decidenti. *Asci* circa 15, aparaphysati, ovati vel globosi, sessiles, 8-spori 30–35 × 25–30 μ, in ordine maturescentes. *Sporae* conglobatae, atrobrunneae, oblongae utrinque rotundatae, 1-septatae, constrictae, leves 20–23 × 9–12 μ cellulis subaequalibus vel superiore leniter crassiore.

Pycnidia thyriotheciis consimilia; sporae ovatae vel piriformes atrobrunneae, leves, 18–22 × 11–14 μ, zona hyalina et poris germinationis deficiuntur.

Hab. in foliis *Uvariae Welwitschii*, Entebbe Road, Uganda, *Hansford 3289*.

105. Asterina thunbergiicola Hansford, sp. n.

Plagulae epiphyllae, orbiculares, griseo-atrae, usque ad 2 mm. diam., tenues, leves. *Mycelium* ex hyphis dilute brunneis sinuosissimis, 3 μ crassis (cellulis plerumque circa 20 μ longis) irregulariter ramosis, laxe reticulatis compositum, maculis retis mycelialis undulatis. *Hyphopodia* dispersa, pauca, 1-septata, 8–13 μ longa, cellula basali cylindracea 3–5 μ longa, cellula apicali saepius curvata, sursum expansa et 2–3-lobata vel pediformia, 5–10 × 4–8 μ, hyphis pluribus secundariis exhyphopodiatis. *Thyriothecia* laxe dispersa, orbiculata, 80–110 μ diam., saepe 2–3-connata, atrobrunnea, dimidiata; paries inferior ex hyphis subhyalinis 2–3 μ crassis, radiantibus compositus; paries superior ex hyphis atrobrunneis, subopacis, radiantibus 2·5–3 μ crassis, cellulis 3–6 μ longis compositus, margine non vel leniter fimbriatus, stellatim dehiscens demum late apertus. *Asci* aparaphysati, ovati vel subglobosi, 8-spori, sessiles, 20–28 μ diam. *Sporae* conglobatae, oblongae utrinque rotundatae brunneae, 1-septatae leniter constrictae, 12–14 × 6–7 μ, cellula superiore leniter crassiore, episporio tenuiter verrucoso-echinulato. Pycnidia non visa.

Hab. in foliis *Thunbergiae chrysops*, Sierra Leone, *Deighton 2181.*

106. Lembosia Carpodini Hansford, sp. n.

Plagulae hypophyllae, griseo-atrae, tenues, orbiculares vel late effusae, leves. *Mycelium* ex hyphis subrectis vel sinuosis brunneis 3·5–4·5 μ crassis (cellulis plerumque 25–35 μ longis) irregulariter ramosis, dense vel laxe reticulatis compositum, maculis retis mycelialis irregulariter angulosis. *Hyphopodia* alternata vel unilateralia, 1-septata, 10–16 μ longa, suberecta, cellula basali cylindracea 2–5 μ longa, cellula apicali clavata vel pediformi rotundata, integra, recta vel curvata, 6–11 × 5–10 μ. *Thyriothecia* dense dispersa, plerumque discreta, elliptica, interdum aggregata et X- vel Y-formia, usque ad 600 × 160 μ; paries inferior ex hyphis flexuosis, hyalinis, ramosis, 4–6 μ crassis compositus; paries superior ex hyphis longitudinalibus vel radiantibus, atrobrunneis 2·5–4 μ crassis, cellulis 4–10 μ longis compositus, margine plus minusve fimbriatus, hyphis fimbriarum tortuoso-radiantibus, saepe lateraliter agglutinatis, exhyphopodiatis, indistincte septatis, usque ad 50 μ longis; thyriothecium longitudinaliter dehiscens. *Asci* numerosissimi, in ordine maturescentes, ovati, sessiles, 2–4-spori, circa 30 × 20 μ. *Sporae* plus minusve parallelae vel conglobatae, oblongae utrinque rotundatae, 1-septatae, constrictae, 19–21 × 8–10 μ, cellula superiore crassiore, episporio verrucoso-echinulato. *Paraphyses* paucae, filformes, 1–1·5 μ crassae, septatae, simplices.

Hab. in foliis *Carpodini dulcis*, Sierra Leone, *Deighton 1820.*

107. Echidnodes Harunganae Hansford, sp. n.

Plagulae epiphyllae, tenuissimae, usque ad 5 mm. diam., leves, in maculis rufobrunneis vel subnigris positae. *Mycelium* ex hyphis brunneis, subrectis, 2–3 μ crassis, indistincte septatis, irregulariter anastomosantibus reticulatisque compositum. *Hyphopodia* pauca, dispersa, singula, continua, pulvinata vel tenuiter 2–3-lobata, 2–4 μ alt. et 6–8 μ cr. *Thyriothecia* pauca, dispersa, elliptica vel elongata, atra, dimidiata,

usque ad 600×150 μ, raro aggregata et X- vel Y-formia ; paries inferior ex hyphis indistinctis hyalinis compositus ; paries superior ex hyphis longitudinalibus vel radiantibus, atrobrunneis, subopacis, 3–3·5 μ crassis, cellulis 4–5 μ longis compositus, margine laxe fimbriatus, hyphis fimbriarum usque ad 100 μ longis, brunneis, radiantibus, flexuosis vel subrectis, exhyphopodiatis, indistincte septatis ; thyriothecia longitudinaliter dehiscentia. *Asci* numerosi, aparaphysati, late ellipsoidei, subsessiles vel breviter nodoso-stipitati, apice rotundati, 25–35×15–20 μ, 8-spori. *Sporae* conglobatae, brunneae, oblongae utrinque rotundatae, 1-septatae, constrictae, leves, 12·5–16×6–7 μ, cellula superiore leniter crassiore. Pycnidia nulla. Mycelium internum in subepidermide efformatum, intercellulare, ex hyphopodia oritur, haustoriis nullis.

Hab. in foliis *Harunganae madagascariensis*, Entebbe Road, *Hansford 3282*.

The few hyphopodia are scattered along the main hyphae, and do not form haustoria in the epidermis in the manner usual in *Asterina* and *Lembosia*, but as the colony develops each becomes surrounded by a small knot of short mycelial hyphae and sends a hypha direct through the cuticle, penetrating between the epidermal cells to the subepidermal layers of the leaf, where a small group of cells, about 15–20 μ diam. is formed. From these internal cells no haustoria are produced in the adjacent host cells, but the latter are stained dark red brown and filled with granular contents, yellow to orange brown in colour, this discoloration extending for some distance from the small patches of internal mycelium and often becoming more or less continuous beneath the whole colony, but rarely extending below the epidermis and subepidermal layers into the palisade tissue. The mature colonies are thus situated on dark reddish brown to almost black leafspots, which persist long after the fungus has matured and disintegrated.

108. Lembosia microcarpae Hansford in Proc. Linn. Soc. London, 153 Sess., p. 48, 1941.

A revised and amplified description is given below, including observations from more recent collections :

Colonies epiphyllous, black, rounded to irregular, dense and subcrustose, up to 6 mm. diam., smooth or rugose in the centre. Mycelium of dark brown hyphae 4·5–5·5 μ wide, the cells mostly 15–30 μ long, substraight to sinuous, radiating outwards, branching usually unilateral or alternate, densely reticulate to form almost a solid plate with the hyphopodia. Hyphopodia numerous, alternate or unilateral, rarely sub-opposite, concolorous, clavate, usually antrorsely bent, entire, continuous, 9–12×6–9 μ. Thyriothecia densely aggregated in the centre of the colony and more or less confluent, at first circular to elliptic, later by confluence irregularly elongate or X- or Y-shaped, very variable in size, from 200 μ diam. up to 800×300–600 μ, subopaque black-brown ; lower wall greenish olivaceous, of irregularly radiating much branched hyphae in 1–2 layers, 3·5–4·5 μ wide ; upper wall of subopaque black-brown radiating hyphae 4–5 μ wide, the cells 5–10 μ long ; margin crenate to shortly fimbriate, the fringing hyphae numerous and laterally connate into more or less continuous sheets ; dehiscence by irregularly longitu-

dinal or stellate fissures, the apex rather widely open at maturity and exposing the central asci, the central parts of the upper wall falling away. Asci numerous, ovate, sessile, 50–60 × 40–45 μ, 8-spored, aparaphysate. Spores conglobate, oblong with rounded ends, 1-septate, slightly constricted, 26–33 × 13–15 μ, the upper cell slightly wider than the lower, both dark brown with small lighter terminal areas which are often flattened or invaginated, surface smooth.

On *Pseudospondias microcarpa* Kiagwe, *Hansford 1359* (type); Mityana, Uganda, *Hansford 3218*.

109. Dictyothrium giganteum Syd. in Phil. Journ. Sci. Bot., ix, p. 178, 1914.

On *Pseudospondias microcarpa*, Mityana, Uganda, *Hansford 3221*.

There is a very fine and loosely reticulate mycelium of hyaline hyphae 1–1·5 μ wide, much branched, indistinctly septate, continuous between the scattered thyriothecia, very difficult to find and only apparent in film preparations. The asci at first are all 8-spored, but only 2–4 spores develop to maturity and these in the same ascus may show considerable divergence in size.

110. **Polyclypeolum Brideliae** Hansford, sp. n.

Plagulae epiphyllae, atrae, saepe numerosae et subconfluentes, leves, in maturitate disrumpentes decidentesque. *Mycelium* ex hyphis dilute brunneis, 1–2 μ crassis, hyphis primariis subrectis, secondariis flexuosis denseque reticulatis, subpelliculosis et fortiter adhaerentibus, exhyphopodiatis, indistincte septatis, anastomosantibus compositum. *Scutella* nigra, irregulariter radianto-ramosa, usque ad 4 mm. diam., ramis usque ad 1 mm. crassis, levibus vel rugulosis; paries inferior indistinctus; paries superior subopace atro-brunneus, ex hyphis meandricis sinuosis 2–4 μ crassis, cellulis 5–8 μ longis compositus, extus levis vel leniter rugulosus, supra loculos leniter elevatus, margine indistinctus et in reliquiis mycelii transiens. *Loculi* laxe irregulariter dispersa, dimidiati, orbiculati vel irregulares, irregulariter rimoso-dehiscentes usque ad 200 μ diam. *Asci* numerosi, clavati, apice rotundati, deorsum longe attenuati, 8-spori, 50–60 × 7–10 μ. *Sporae* oblique 2–3-seriatae, fusoideae vel clavulato-ellipsoideae utrinque rotundatae, rectae vel curvulae, hyalinae, leves, 1-septatae haud constrictae 8–11 × 2·5–3 μ, cellula superiore lenissime crassiore. *Paraphyses* primo numerosae, ramosae, hyalinae vel dilute brunneae, demum mucosae.

Hab. in foliis *Brideliae micranthae*, Entebbe Road, Uganda, *Hansford 3309*.

The fungus is extremely common on this host in many parts of Uganda, but ripe loculi are rarely evident. The very thin subpelliculose mycelium very rapidly forms closely scattered knots of hyphae, which enlarge and coalesce to form the irregularly radiate composite scutella, leaving only a few hyphae between them. At first the whole colony is strongly adherent, but as it matures it tends to break up into irregular fragments which become easily detached from the leaf, finally leaving little or no sign of their presence. Beneath the scutella the hymenia are irregularly and loosely scattered, separated by considerable areas of sterile stroma,

the latter consisting only of the upper plectenchymatous wall, formed by the agglutination of meandering shortly septate dark brown subopaque hyphae. There appears to be no penetration of the leaf cuticle and the mycelium is exhyphopodiate.

111. **Lecideopsella gelatinosa** Hansford, sp. n.

Ascomata hypophylla, orbiculata, subdiscoidea, tenuia, usque ad 350 μ diam., levia, virideo-albida vel grisea, firme gelatinosa, laxe dispersa, mycelio libero nullo ; contextus ex hyphis hyalinis 1 μ crassis, indistincte septatis, irregulariter ramosissimis, laxe intertextis, mucosis compositus. *Asci* in contexto laxe irregulariterque dispositi, globosi 16–19 μ diam., 8-spori, aparaphysati. *Sporae* parallelae vel conglobate, hyalinae, oblongae utrinque rotundatae, 1-septatae, non vel lenissime contractae, leves, $10 \times 2\,\mu$ cellulis subaequalibus.

Hab. in foliis *Jasmini dichotomi*. Entebbe Road, Uganda, *Hansford 3233*.

The ascomata are completely superficial without evident free mycelium, loosely and irregularly scattered over the lower surface of the leaf, thin, flattened discoid, rounded, greenish white to grey, smooth. The whole tissue of the ascoma consists of loosely interwoven very fine hyaline hyphae embedded in mucus, the whole firmly gelatinous when fresh. In this ground tissue the asci are scattered irregularly, the young asci being single and terminal on the ends of branched flexuous hyaline hyphae 1·5–2 μ wide, penetrating between those of the ground tissue ; the small vesicles first formed are cut off by a basal septum and enlarge to form the mature globose asci.

112. **Stagonospora phragmiticola** Hansford, sp. n.

Maculae amphigenae, orbiculatae vel lenticulatae, centro griseo-brunneae vel subalbidae, usque ad 5×2 mm., margine brunneae. *Pycnidia* plerumque epiphyllae, laxe dispersa vel 2-3-aggregata, immersa, globosa, atra, glabra, 60–100 μ diam., tenuiter membranacea : paries 1–2-stratosus ex cellulis angulosis olivaceis 8–12 μ diam. compositus, intus dilutior et in stratum unum hyalinum conidiiferum transiens. *Conidia* cylindracea utrinque rotundata, recta vel curvula, hyalina, levia, 2-septata haud constricta $20–33 \times 5{\cdot}5–6{\cdot}5\,\mu$, cellula centrali majore.

Hab. in foliis *Phragmitis mauritiani*, Kawanda, Uganda, *Hansford 3212*.

The pycnidia are loosely scattered, single or in small loose lumps, on grey-brown to almost white leafspots, each surrounded by a dark brown margin. The pycnidia are completely immersed, with merely the apical pore penetrating the upper epidermis of the leaf and not projecting above it, globose, black, glabrous, thinly membranous, with a parenchymatous wall of 1–2 layers of dark cells, lined with a single layer of smaller hyaline parenchyma on which the conidia are borne direct on small papillae, one to each cell.

113. Microdiplodia melaspora (Berk.) Griff. & Maubl. in Bull. Soc. Myc. France, xxv, p. 55, 1909.

On *Saccharum spontaneum* var. *aegyptiacum*, Kawanda, Uganda, *Hansford 3211*.

114. Eriomycopsis Englerulae Hansford, sp. n.

Mycelium in plagulis *Englerulae* parasitans, plagulas tenues effusas albas efformans et ex hyphis hyalinis flexuosis septatis ramosis 1–3 μ crassis, dense reticulatis compositum. *Conidiophora* erecta hyalina, simplicia vel raro superne furcata, 70–130 μ longa, cylindracea vel sursum leniter attenuata, 3–5-septata, deorsum circa 5 μ crassa, apicem versus verruculosa propter sterigmata brevissima. *Conidia* terminalia, singula, hyalina, clavato-cylindracea, apice rotundata, deorsum ad basim 1 μ cr. attenuata, 3-septata, haud constricta, 25–35 × 7–9 μ, plerumque 30–32 μ longa, levia, faciliter collabentia, basi sterigmate 1–2 × 1 μ praedita.

Hab. in plagulis *Englerulae Macarangae* P. Henn. in foliis *Macaranga Schweinfurthii*, Mityana, Uganda, *Hansford 3217 p.p.*

This species is close to *E. tenuis* Syd., differing in shorter, less branched conidiophores producing the conidia rather close together at the apex.

115. Tetracium Piperis Hansford, sp. n.

Mycelium hypophyllum ex hyphis hyalinis, flexuosis, 2–2·5 μ crassis, indistincte septatis, ramosis, laxe reticulatis, superficialibus compositum. *Conidia* laxe singulariterque dispersa, in ramulis erectis brevibus simplicibus mycelii terminaliter producta, radiata, hyalina, radiis 6–8, plerumque 2–seriatis, simplicibus, rectis vel curvulis, ex basi 6–7 μ cr. ad apicem rotundatam 2–3 μ cr. attenuatis, 2–3-septatis, haud constrictis, levibus, late divergentibus.

Hab. in foliis *Piperis capensis*, Entebbe Road, Uganda, *Hansford 3238*.

The fungus is not visible to the naked eye, and consists of apparently entirely superficial loosely reticulate hyaline hyphae wandering over the leaf surface and producing conidia singly at the ends of short erect, widely scattered branches. Each conidium consists of 6–8 widely divergent radii, each of 3–4 cells and gradually attenuate from the base to the rounded apex, usually arranged in two superimposed series of 3–4 radii ; the whole fungus is completely hyaline and apparently saprophytic.

116. Hadronema Penniseti Hansford, sp. n.

Plagulae atrobrunneae, tenuissimae, velutinae, superficiales, effusae, amphigeneae. *Mycelium* ex hyphis repentibus 3 μ crassis dilute olivaceis, irregulariter ramosis, flexuosis, passim in nodis aggregatis compositum. *Conidiophora* erecta, recta vel flexuosa, deorsum atro-olivacea, sursum dilutiora, cylindracea, usque ad 250 μ longa et 5 μ crassa, plerumque simplicia, septata, sursum propter sterigmata sparsa verruculosa. *Conidia* acropleurogena, singula, ovata vel ellipsoidea, dilute olivacea, 1-septata, non vel lenissime constricta, cellulis aequalibus, apice late rotundata, basi rotundata, hilo parvo atro haud prominenti praedita, episporio echinulato, conidia matura 21–28 × 9–13 μ.

Hab. in foliis *Penniseti purpurei*, Nagoje, Kiagwe, Uganda, *Hansford 2807*.

117. Helminthosporium Balladynae Hansford, sp. n.

Mycelium ex hyphis dilute griseo-brunneis vel subhyalinis, 1·5–2·5 μ crassis, septatis, flexuosis, irregulariter ramosis, exhyphopodiatis, supra et inter hyphas hostis dense intertextis et plagulam prope solidam

efformantibus compositum. *Conidiophora* erecta, singula vel plus minusve dense fasciculata, dilute brunnea sursum subhyalina, simplicia vel sursum furcata, flexuosa, 3–6-septata, levia, 100–200 × 5–6 μ, ad cicatrices conidiorum leniter geniculata. *Conidia* clavata, apice late rotundata, deorsum ad hilum basi 3 μ cr. sensim attenuata, recta vel curvula, 3-septata, haud constricta, levia, dilute griseo-brunnea, 30–40 × 8–10 μ.

Hab. in plagulis *Balladynastri entebbeensis* Hansf. in foliis *Grumileae succulentae*, Entebbe Road, Uganda, *Hansford 3264*.

This species is distinguished from other 3-septate hyperparasites of the genus by the absence of a conidial beak and by the pale colour and large size of the conidia.

118. **Acrospeira Balladynae** Hansford, sp. n.

Mycelium ex hyphis dilute olivaceis, flexuosis, irregulariter ramosis, septatis, 2–4 μ crassis, supra et inter hyphas hostis reticulato-intertextis compositum. *Conidiophora* singulariter dispersa, erecta, dense dispositia opposita vel alternata, lateralia, continua, atrobrunnea, sursum sensim attenuata, basi inflata integra vel sublobata 5–7 μ diam., recta, levia, 25–40 μ longa et apice 2 μ crassa. *Conidia* singula terminalia, clavata, muriformia, 18–24 μ longa, 14–18 μ lata et plerumque 8–9 μ crassa, rotundato-triangulata, levia, castaneo-brunnea, cellula basali obconica dilutiora, unde series 2–4, quaeque cellulas 2–3 continens, exoriuntur et laminam vel massam efformant, ad septa non vel leniter constricta.

Hab. in plagulis *Balladynae leonensis* Syd. in foliis *Oxyanthi unilocularis*, Entebbe Road, Uganda, *Hansford 3288* (typus) ; in folii Rubiacearum spec. indet. l. c., *Hansford 3308*.

The conidiophores are unicellular, erect from a swollen base adherent to the leaf and lateral on the parent hypha, straight, much darker than the mycelium, simple and forming a single terminal conidium. This consists of an obconic brown basal cell, from which usually two series of much darker, chestnut-brown cells arise and form a flat plate of 4–6 cells ; sometimes four similar series of cells are formed and in such conidia a solid pyramidal mass of dark cells is formed.

119. **Cercospora Eriosemae** Hansford, sp. n.

Maculae indistinctae, dilute brunneae (hypophyllae, dilutiores vel griseo-brunneae), emarginatae 1–4 mm. diam. vel in confluendo majores irregulares. *Conidiophora* hypophylla, inter pilos folii, aegre perspicuia erecta, singula vel 2–6-fasciculata, olivacea, usque ad 250 × 4–5 μ, simplicia vel plerumque irregulariter furcata, ad cicatrices conidiorum prominulas geniculata. *Conidia* dilute olivacea, cylindracea vel anguste obclavata, levia, 2–6-septata, haud constricta, 50–90 μ longa, 4–6 μ crassa, ad apicem 2 μ cr. et ad hilum planum basis 2–3 μ crassum sensim attenuata, recta vel curvula, hilo concolorato aegre prominulo. Cicatrix conidii in conidiophoro haud incrassata, tantum plana concolorata.

Hab. in foliis *Eriosemae psoraleoidis*, Semuto Road, Uganda, *Hansford 3313* (typus) ; in foliis *Eriosemae* spec., *Hansford 2553*.

120. **Cercospora Allophylli** Hansford, sp. n.

Maculae nullae. *Mycelium* hypophyllum ex stomatibus folii emergens

et inter pilos folii repens, ex hyphis olivaceis flexuosis 2–3 μ crassis, irregulariter ramosis, septatis compositum. *Cespituli* atrobrunnei, usque ad 10 mm. diam. *Conidiophora* singulariter dispersa vel plus minusve dense fasciculata, erecta, olivacea, simplicia vel irregulariter furcata, septata, usque ad 180 × 4–5 μ, flexuosa, sursum ad cicatrices conidiorum geniculata. *Conidia* cylindracea, olivaceo-brunnea, apice rotundata, basi subtruncata, recta vel curvula, 1-6-septata, haud constricta, levia, 14–120 × 3–4 μ, sursum aegre attenuata, hilo plano concolorato aegre prominulo praedita. Saepe conidia majora apice conidiifera.

Hab. in foliis *Allophylli* spec., Semuto Road, Uganda, *Hansford 3317*.

121. ARTHROBOTRYUM sp.

On *Meliola* on *Sorindeia juglandifolia*, Sierra Leone, *Deighton 441*.

Coremia closely scattered, erect, climbing up the setae of the *Meliola* host and enclosing them, extending up to 150 μ beyond, yellow brown, loose, scattered over the host colony ; stalk portion of dense parallel narrow yellow-brown hyphae 2–3 μ wide, septate, about 20 μ diam. Head loosely expanded, up to 150 μ long by 100 μ diam., consisting of the swollen ends of the stalk hyphae, 4 μ wide, indistinctly septate, forming conidia single at the tips, pale yellow brown, the individual hyphae subhyaline. Conidia yellow-brown in mass, pale yellowish when single, fusoid with curved narrow apical beak, rounded-attenuate at the base, 3-septate, not constricted, 40–49 × 6–7·5 μ, the surface distinctly verrucose except on the apical beak.

This differs from *A. parasiticum* (Wint.) Hansf. in the rather larger conidia with rough surface, and in its habit of enclosing the mycelial setae of the host, but a further range of specimens is needed to determine whether these differences are sufficiently constant to distinguish this as a separate species.

122. **Isariopsis Neoboutoniae** Hansford, sp. n.

Maculae indistinctae, griseo-brunneae, hypophyllae, plus minusve effusae, 5–15 mm. diam. vel in confluendo multo majores. *Coremia* singulariter laxeque dispersa, erecta, semper hypophylla, atra, usque ad 350 μ longa et 10–15 μ diam., basi vix expandita, ex hyphis plus minusve dense parallele aggregatis, atrobrunneis sursum divergentibus et ad cicatrices conidiorum lenissime sinuoso-geniculatis composita. *Conidia* singula, terminalia, cylindracea, dilute olivacea vel subhyalina, apice rotundata, basi subtruncata, 1–3-septata, haud constricta, levia, 15–45 × 5–6 μ, hilo aegre perspicui praedita.

Hab. in foliis *Neoboutoniae Melleri*, Semuto Road, Uganda, *Hansford 3329*.

PROCEEDINGS OF THE SPECIAL GENERAL MEETING
8 February 1945

held jointly with The Zoological Society of London.

Mr. A. D. Cotton, O.B.E., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 23 November 1944, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Dr. R. E. G. Armattoe, Prof. G. D. Hale Carpenter, Mr. James Hornell, Dr. N. Polunin, Miss S. Shannon (for 'Britain in Pictures'), and Prof. F. E. Weiss.

The following Fellow signed the Obligation in the Book of the Charter and Bye-Laws and was admitted :—Dr. Reginald Edward Vaughan.

The President reminded Fellows that underBye-Laws, Chap. 8, Sect. 2. Fellows are entitled to make recommendations for new Members of Council and Officers.

The President reported the deaths of the Rev. Prof. Edward Shefford Lyttel, Lt.-Col. Andrew Thomas Gage, C.I.E., and Lt.-Col. Frederick Robert Stephen Balfour, C.V.O., J.P., D.L., Fellows of the Society.

The President referred to Colonel Gage's services to the Society, both as a member of the staff from 1924–29 and as the author of 'A History of The Linnean Society of London', published by the Society in 1938. A vote of condolence to Mrs. Gage was passed in silence.

The following communications were read and discussed :—

Dr. F. W. Jane. A revision of the genus *Harpochytrium*. (Discussed by Dr. V. J. Chapman, Dr. J. Ramsbottom, O.B.E., Prof. C. T. Ingold, Mr. D. J. Scourfield, I.S.O., and the President ; Dr. Jane replied.) [This paper will be printed in full in the Journal, Botany.]

Abstract.—

With the exception of *H. apiculatum* Pascher, all the species of *Harpochytrium* have been examined in detail ; this has led to a revision of the genus, in which six species are recognized. Of these, two, *H. Botryococci* from Caernarvonshire and *H. monae* from Anglesey are new ; *H. Atkinsonianum* Pascher and *H. adpressum* Scherffel are regarded as forms of *H. Hedinii* Wille, while *H. tenuissimum* Korsch. (*in sensu* Jane) includes *H. tenuissimum* Korsch. and the plant referred to by Scherffel and Pascher as *H. intermedium* Atkinson. The so-called green *Harpochytrium viride* Scherffel is excluded.

The systematic position of the genus is obscure. If the plants be non-pigmented xanthophycean algae, their siphoneous habit, and the occasional occurrence of branched specimens, suggests that they should be assigned to the Heterosiphonales rather than to the Heterococcales, in which order they are often placed. If the plants be fungi, then it is extremely unlikely that they are chytridiaceous; the relatively large portion of the plant which remains sterile, the apparently unlimited growth in length, the coenocytic habit and the potentiality for branching, and perhaps the potentiality for forming cellulin plugs, suggest affinities with the lower Oomycetes, although there is no evidence that *Harpochytrium* reproduces by sexual means.

The so-called *H. virida* differs from *Harpochytrium* in possessing chlorophyll, in being uninucleate, and in its zoospore attaching itself by its anterior end and not by the tip of its flagellum as in *Harpochytrium*. It is held that its tubular form and its proliferating sporangium are not sufficient evidence for regarding it as closely related to *Harpochytrium*; it is, without question, a xanthophycean alga, and has been renamed *Chytridiochloris viridis*.

Prof. C. T. Ingold. The tetra-radiate spores of certain aquatic Hyphomycetes and the propagules in some species of *Sphacelaria*. (Discussed by Dr. V. J. Chapman, Mr. A. G. Lowndes, Dr. R. Melville, Dr. J. Ramsbottom, O.B.E., and the President; Prof. Ingold replied.) [Printed below.]

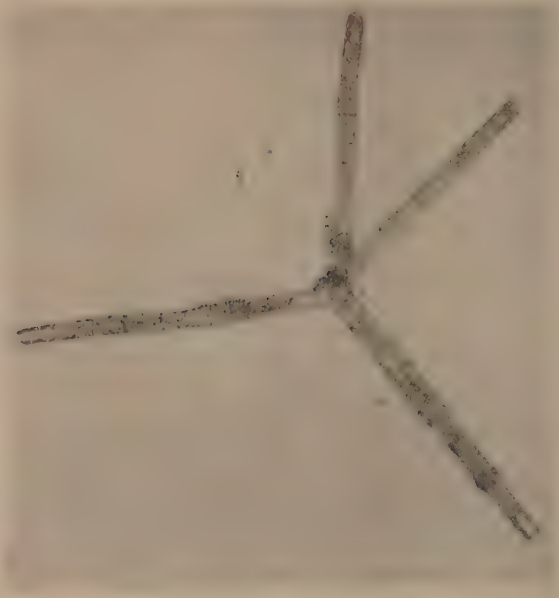
THE TETRA-RADIATE SPORES OF CERTAIN AQUATIC HYPHOMYCETES AND THE PROPAGULES IN SOME SPECIES OF SPHACELARIA.

By C. T. Ingold.

In aquatic Hyphomycetes (Ingold, 1942, 1943*a*, 1943*b*, 1944), which grow so abundantly on decaying leaves of deciduous trees and shrubs in well-aerated waters, a striking feature of several genera (*Lemonniera*, *Articulospora*, *Clavariopsis*, *Alatospora*, *Tetracladium*, *Tetrachaetum* and *Triscelophorus*) is the tetra-radiate conidium with its four long filamentous arms diverging from a common point. That this odd kind of spore has developed along a number of independent lines of evolution is suggested by the ontogeny of the spore in the different genera. The parallel development of the tetra-radiate spore in so many genera suggests that it has some special biological value in the aquatic habitat.

Recently Dr. M. A. P. Madge drew my attention to the similarity of these tetra-radiate fungal spores to the propagules in some species of *Sphacelaria*, a genus of brown seaweeds.

Of the 38 species of *Sphacelaria* considered by Sauvageau (1900–04) in his monograph of the genus 14 possess propagules. These are specialized lateral branches of limited growth and definite form which are liberated as reproductive units. The form of the propagule varies from species to species. In *S. fusca*, and sometimes in *S. variabilis*, it consists of four



A. Propagule of *Sphacelaria* sp. ×167.

B. Spore of *Lemonniera aquatica* de Wild. ×744.

divergent filamentous arms very much recalling the spores of *Lemonniera aquatica* or *Tetrachaetum elegans*,. In *Sphacelaria hystrix* and *S. cirrhosa*, in addition to four divergent arms, there is also a filamentous hair.

Like the spores of aquatic Hyphomycetes, the propagules of *Sphacelaria* are produced, liberated and dispersed below water. In the dispersal of the aquatic spore and of the propagule there are three important episodes : (1) the liberation of the reproductive unit, (2) its actual dispersal in the water and (3) its eventual arrest on a suitable substratum. Perhaps the tetra-radiate reproductive unit is of special value in this final episode, behaving as a sort of anchor readily becoming entangled in such a substratum as a decaying leaf or an algal tuft. Sauvageau made this suggestion for the branched propagules of *Sphacelaria* and, independently, much the same suggestion (Ingold, 1942) was put forward for the biological value of the tetra-radiate fungal spores.

References.

Ingold, C. T. (1942). Aquatic Hyphomycetes of decaying alder leaves. *Trans. Brit. myc. Soc.*, xxv, 339–417.

—— (1943 *a*). Further observations on aquatic Hyphomycetes of decaying leaves. *Trans. Brit. myc. Soc.*, xxvi, 104–15.

—— (1943 *b*). *Triscelophorus monosporus*, n. gen., n. sp., an aquatic hyphomycete. *Trans. Brit. myc. Soc.*, xxvi, 148–52.

—— (1944). Some new aquatic Hyphomycetes. *Trans. Brit. myc. Soc.*, xxvii, 35–47.

Sauvageau, C. (1900–4). Remarques sur les Sphacélariacées. *Jour. de Bot.*, xiv–xviii.

Mr. Ashley G. Lowndes. The swimming of *Monas* (Protozoa). (Discussed by Dr. Edward Hindle, F.R.S., who also read some comments by Sir John Graham Kerr, F.R.S., Dr. V. J. Chapman and Mr. D. J. Scourfield, I.S.O. ; Mr. Lowndes replied.)

Abstract.—

The species studied was *Monas stigmatica* Pringsheim, obtained from a culture supplied by Prof. E. G. Pringsheim from the Type-Culture Collection of Algae, the Botany School, Cambridge.

It appears to be a very typical species and its swimming movements can be regarded as being more or less normal.

It was found that under the proper conditions the organism swam at a rate of 260 μ per sec., which means that it was traversing in one second a distance of 40 times its own length. This being so, it should be obvious that it is quite impossible to study the normal swimming movements by means of dark-ground illumination, or by any means other than ultra-rapid cinema photo-micrography.

In 1925 Krijsman published his well-known paper on the movement of the longer of the two flagella in an unnamed species of *Monas* which he studied by means of dark-ground illumination, and in spite of the difficulties he made a very valuable contribution and laid down what are now known to be the two fundamental points in connection with the swimming of the monoflagellates, namely :—(1) The waves or impulses start at the base of the flagellum and not at the tip ; (2) as the organisms move forward they both rotate and gyrate.

It is claimed that in the swimming of the monoflagellates in general the function of the flagellum is primarily to cause the organism to rotate and gyrate, and it is this gyration and rotation which produces the forward component in the swimming of the organism.

The matter is of considerable importance from the point of view of organic evolution, for it indicates that the first type of swimming movement evolved was that of the inclined plane or the propeller, which is the simplest and most efficient of all mechanical devices used in a fluid medium.

It is still stated in the majority of text-books that in an organism such as *Euglena* the waves or impulses start at the tip of the flagellum and draw the organism through the water. This concept is incorrect, and it is founded on no sort of scientific observation.

Paper read in title :—

'Materials for a revised Flora of Palestine.—I.' by Dr. NAOMI FEINBRUN. [Printed in full below.]

MATERIALS FOR A REVISED FLORA OF PALESTINE.—I.

By NAOMI FEINBRUN, Hebrew University, Jerusalem.

Through the kindness of Mr. J. E. Dinsmore (American Colony, Jerusalem) it has become possible for the writer to use the Herbarium of Post (American College of Beirut), as well as Mr. Dinsmore's own herbarium, for the past few years. Thus she was able to verify various older records of the Palestinian Flora, which had remained dubious after the publication of the revised edition of Post's Flora (G. E. Post, 'Flora of Syria, Palestine and Sinai', revised by J. E. Dinsmore, 1931–33), and of the catalogue of Palestinian plants by Eig (A. Eig, 'Les éléments et les groupes phytogéographiques auxiliaires dans la flore palestinienne'. Tableaux analytiques. Fedde, Repert. Beihf. Bd. 63, 2). Some of the results of the revision are given here. Several plants new for Palestine, found during the last few years by various collectors, are also recorded here.

Abbreviations used in this paper.

DISTRICTS.—A : Amman ; AP : Acre Plain ; C : Carmel ; E : Edom ; EP : Esdraelon Plain ; FN : Far Negeb ; HP : Huleh Plain ; J : Judean Mountains ; LG : Lower Galilee ; S : Sharon ; SA : Samaria ; SH : Shephela; UG : Upper Galilee : UJ : Upper Jordan Valley.

COLLECTORS : E. A. Eig ; F. N. Feinbrun ; Z. M. Zohary.

HERBARIA : DiH : Dinsmore Herbarium ; PH : Post Herbarium. When not otherwise mentioned, the plants are preserved in the Herbarium of the Botanical Department of the Hebrew University.

VIOLACEAE.

Viola pentadactyla Fenzl var. *parviflora* Feinbr., var. nov.

Flores minores, petala calyci aequantia, calcar appendice calycino paulo longius vel subsequilongum.

Jerusalem, fields (1941 D. Zohary, 1942 Kushnier).

The type variety has not been found in Palestine.

PRIMULACEAE.

Cyclamen coum Mill.

UG2 : Top of Jebel Jermak, maquis in humus (1942 P. H. Davis).

This species is apparently restricted to Asia Minor, Syria, and Northern Palestine. The species has been previously recorded from the Caucasus and Bulgaria. But in the Caucasus *C. coum* is replaced by *C. ibericum* (according to Grossheim), and in Bulgaria and Southern Roumania (Dobrogea) by *C. durostoricorum* Pantu & Solacolu. We could not find out from which locality the type specimen *C. coum* originated. The species was probably described by Miller from a cultivated plant. Bornmueller (' Florula Lydiae ', 1908) supposes that *C. coum* occurs on Takhali-dagh : a farmer from Bunerbaschi told him about a small-corned *Cyclamen* which he used to supply to Withall Co., in Smyrna.

SCROPHULARIACEAE.

Linaria Cymbalaria Linn.

Jerusalem, waste places (1917 Meyers and Dinsmore DiH) ; Jerusalem, shady wall (1940 D. Zohary).

Not recorded at all in Boissier's ' Flora Orientalis '. Chiefly a west Mediterranean species.

Herpestis Monnieria (Linn.) HBK.

Near the Genezareth Lake (1941 Palmoni).

Known till now in Palestine from the Palestino-Egyptian boundary (Coastal Negeb) only.

Veronica stenobotrys Boiss.

UG : Jebel Jermak, in *Quercus calliprinos—Quercus infectoria* maquis (1942 F).

var. *leiocarpa* Boiss.

Together with the type.

This species varies in hairiness of the fruit and calyx lobes. Eig (1932) admitted that only var. *leiocarpa* occurred in Palestine, and he recorded it as a separate species (*V. leiocarpa* Boiss.). However, on new and abundant material from Palestine and Syria, we could ascertain that both, the type and the variety, occurred generally together. The glabrous form is thus a mere variety of *V. stenobotrys* Boiss.

Veronica Tournefortii Gmel.

UJ : Tiberias, vegetable garden (1923 E) ; EG : Rosh-Pinah (1926 Z 1937 Rayss).

LABIATAE.

Lamium striatum Sibth. et Sm. var. *minus* Boiss.

UG : Jebel Jermak, in *Quercus calliprinos—Quercus infectoria* maquis (1942 F).

This plant has been recorded by Post from Gilead without exact locality.

Ballota foetida Lam.

SA : Nablus (1908 No. 142 Dinsmore DiH).

This specimen is recorded in Post's Flora (1933) under *B. nigra* Linn. The latter is an Eurosiberian-Boreoamericanian species, whereas *B. foetida* is a Mediterranean one.

Teucrium Montbretti Benth.

SA : Wadi Suwenit, below Mihmas, shade of overhanging cliffs (1942 P. H. Davis).

This East-Mediterranean species has been known till now as far south as Northern Syria. Our record widens the range of the species much to the south. We also possess a specimen from the cliffs between Batroun and Tripoli (1931 E Z) ; this specimen constitutes thus a connecting link with our new and rather remote station in Palestine.

Teucrium leucocladum Boiss.

FN : North-west of 'Aqaba, Wadi el Masri, 5 km. off the mouth of the Wadi, in furrow of granite rocks, 225 m. ; *ca.* 8 km. North of Ras el Naqb, valley between granite hills, gravel and sand, 780 m. (1936 E F Z).

Reported from Wadi Hebran of Sinai.

ALISMATACEAE.

Alisma Plantago-aquatica Linn.

HP : Lake Huleh, in water (1941 Mendelson).

The species usually recorded under this name from Palestine is *A. lanceolatum* (Eig et Feinbrun, 'New Plants of Palestine', Palest. Journ. of Bot., J. Ser. 1939). This is the first specimen of the true *A. Plantago-aquatica* found in Palestine. The nearest station in Syria given by Samuelsson (1932) is between Zahle and Baalbeck, in the valley of Caelesyria forming the northern continuation of the Jordan Valley.

SPARGANIACEAE.

Sparganium neglectum Beeby.

S : Wadi Musrara, near Tel-Aviv (1925 E), Petach-Tiqwa (1921 E) ; EP : Rub'a el Nasra marsh (1923 Z) ; UG : Dan (1923 Naftolsky) ; HP : Huleh, near Wasieh (1924 E).

var. *oocarpum* (Ostenf.) Čelak.

HP : Marshes of Huleh (1924 E).

This species has been recorded from Palestine under *S. ramosum* Huds.

ORCHIDACEAE.

The difficulty in the identification of dried Orchids caused many inaccurate data to be entered into the list of Palestinian Orchids by botanists who were unable to study them in a living state. Closer examination of living material from different parts of the country as well as access to older herbaria enabled the writer to revise and correct the list of Palestine species of this fascinating family.

The literature used for this revision is: (1) Schlechter, R. (1928), 'Monographie der Gattungen und Arten', vol. I of 'Monographie und Iconographie der Orchideen Europas und des Mittelmeergebietes', by G. Keller und R. Schlechter. (2) Keller, G., and Soó, R. (1930–33), 'Kritische Monographie', etc., vol. ii of 'Monographie und Iconographie', etc. (3) Renz, J., various papers in Fedde's Repertorium.

Ophrys Speculum Link (Sect. *Myodes*).

I have not seen this Western Mediterranean species from Palestine. The record from Palestine by Schlechter (1928) and Soó (1930) is based on data of Tristram, most of which have to be verified.

Ophrys lutea Cav. ssp. *galilaea* (F. et Bornm.) Soó (v.v.s.) (Sect. *Myodes*).

This is the only form of the cyclus of *O. lutea* found in Palestine. All records of *O. lutea* in Post's Flora (1933) are to be referred to ssp. *galilaea*.

Soó (1930) mentions this form as 'die zweifelhafte, nach einem einzigen Exemplar beschriebene, vielleicht monstroese ssp. *galilaea* aus Syrien'. We possess specimens of this plant from all mountainous parts of Mediterranean Palestine (Judea, Samaria, Carmel, Upper Galilee). It is one of the first *Ophrys* species of the rainy season.

Ophrys fusca Link (v.v.s.) (Sect. *Myodes*).

It is the commonest *Ophrys* species of Palestine at the beginning of the rainy season (January–February). Occurs in all Mediterranean parts of Palestine.

Ophrys iricolor Desf. (v.v.s.) (Sect. *Myodes*).

This showy *Ophrys* is rare in Palestine. It is recorded by Post (1933) only from the Jerusalem district, but has been recently found also on Mount Carmel (1941, Kushnier).

Ophrys fuciflora Hal. (v.v.s.) (Sect. *Arachnites*).

UG: Jebel Jermak (1942 Zaitchek); Alonim (between Haifa and Nazareth) in the Quercetum ithaburensis (1941 Kreize, 1942 Feinbrun); C: Mount Carmel, Esfiah to Yagur (1942 Kushnier) and Dalia (1941 Weissman); J: Ain Tulma (1915 Dinsmore 4602 sub. *O. oestrifera*); Artuf to Deir esh-Sheikh (1926 Zohary).

Schlechter (1928) and Soó (1930) doubt the occurrence of this species in Palestine. In fact it is rather rare and occurs only in the maquis.

Ophrys tenthredinifera Willd. (Sect. *Arachnites*).

This West-Mediterranean species does not occur in Palestine. The record in Post's Flora (1933) from Judea is based on a wrongly determined specimen of *O. Dinsmorei* Schltr.

Ophrys Bornmuelleri M. Schulze (v.v.s.) (Sect. *Arachnites*).

This East-Mediterranean plant is one of the showy *Ophrys* species of Palestine. The sepals are white or pinkish. It is found in the maquis or batha of the Mediterranean territories of Palestine, and is flowering chiefly in April. We doubt that *O. grandiflora* Fleishm. et Soó is a constant form.

Ophrys mammosa Def. (Sect. *Arachnites*) and *O. ferrum-equinum* (Sect. *Arachnites*).

These species do not occur in Palestine. Both were recorded by Tristram only.

Ophrys Spruneri Nym. (Sect. *Arachnites*).

The data on this species in Post's Flora (1933) have to be referred to *O. Sintenisii*.

Ophrys Sintenisii Fl. & Bornm. (v.v.s.).

This species is one of the commonest *Ophrys* species of Palestine and is known to us from all Mediterranean districts of Palestine. It has green sepals, brownish-green petals, and a dark purple labellum. The labellum varies slightly from lobed to entire.

Ophrys oestifera MB. (Sect. *Poicilophrys*).

This species does not occur in Palestine. The writer identified three specimens under this name mentioned in Post's Flora : the specimen from Mount Carmel (Post Herbarium) proved to be *O. Bornmuelleri* M. Schultze, those from Galilee (Post Herbarium) and from Ain Tulma, Judea (Dinsmore Herbarium) were *O. fuciflora* Hall

Ophrys cornuta Stev. (Sect. *Poicilophrys*).

This species does not occur in Palestine. The records of Barbey (' forma non cornigera ') and of Killermann are dubious.

Ophrys Dinsmorei Schltr. (v.v.s.) (Sect. *Poicilophrys*).

UG : Kefar Gileadi (1925 Smoly, 1941 F Z) ; Hurfesh (1927 Smoly) ; LG : Nazareth (1927 Meyers et Dinsmore DiH). C : Carmel (1922 E). SA : Wadi Siqqiya to Wadi Rijan (1930 F Z). J : Jerusalem, Mount Scopus (1931 Amdursky) ; Artuf (1924 E). S : Hedera (1927 E). SH : Rishon le Zion (1925 E).

Soó (1931) regards *O. Dinsmorei* as synonymous with *O. carmeli* Fl. et Bornm., and prefers the last name, although both were given in the same year. The writer prefers to retain the name *O. Dinsmorei*, because almost all the specimens seen correspond better with the description of Schlechter, which differs from that of *O. carmeli* in several points. The petals of *O. Dinsmorei* are described as 4 mm. long and 2 mm. broad, those of *O. carmeli* as 3 mm. × 3 mm. ; the length of labellum in *O. Dinsmorei* 7 mm., in *O. carmeli* 10 mm. These characteristics do indeed somewhat fluctuate ; several sheets from Hedera in our Herbarium show transitions from larger flowers to the smaller typical ones. The majority of our specimens are rather typical *O. Dinsmorei*. Thus *O. carmeli* is regarded by the writer as an untypical *O. Dinsmorei*.

The colour of the flower was not known to Schlechter. The colour of the sepals and petals is green or white, that of the labellum is dark brown getting paler during anthesis ; the recurved margins of the labellum and the appendix are green.

Ophrys apifera Huds. (v.v.s.) (Sect. *Poicilophrys*).

This showy species is rare in Palestine. It has been found on Mount Gilboa among rocks (1942 Kushnier); near Ramallah (1942 Girls School) and on Mount Carmel (1945 Weiss).

The number of *Ophrys* species of Palestine is thus eight.

Serapias vomeracea (Burm.) Briq. (v.v.s.) (Sect. *Bilamellaria*).

Found in almost all Mediterranean districts of Palestine.

Anacamptis pyramidalis (Linn.) Rich. (v.v.s.).

Rather common in the mountainous parts of Mediterranean Palestine. One of the latest orchids of the season (flowering in May). Has a pleasant smell.

Himantoglossum Bolleanum (Siehe) Schltr.

UG: Top of Jebel Jermak, 1200 m. (1943 A. Israëlith).

This East-Mediterranean species is new for Palestine. Schlechter (1928) records its distribution: 'In Juniperus Waeldern, bisher nur aus Cilicien; wahrscheinlich duch in Nord-Syrien'. Post's second edition does not record it from Syria.

Upon comparison of the above specimen with *H. affine* (Boiss.) Schltr. from Duluk Baba near Aintab (1889 Shepard PH) the writer concludes that the maintaining of *H. Bolleanum* as a separate species is justified.

A specimen of *H. affine* from Olympus, Bithynia (PH) has also been examined. This species has not been mentioned by Schlechter from that part of Asia Minor.

Neotinea intacta (Link) Rchb. f.

The plant is very rare in Palestine. It has been found till now only in the Judean Mountains (the specimen recorded in Post's Flora has been verified by the writer).

Orchis papilionaceus Linn. var. *minimum* Camus (v.v.s.) (Sect. *Phalaenanthus*).

The typical *O. papilionaceus* does not occur in Palestine. The writer determines the Palestinian form as var. *minimus* Camus recorded from Cilicia and Syria. Although the Palestinian specimens have a larger labellum, reaching 8 mm. in width (and not only 5 mm.), they seem to correspond better to this than to any other described variety which all possess much larger flowers. *O. papilionaceus* var. *minimum* is one of the commonest Orchids of Palestine.

Orchis morio L. (Sect. *Morianthus*).

The specimens recorded in Post (1933) under this name from Palestine were examined. They belong to *O. saccata*.

Orchis pictus Lois.

UG: near Peki'in (1927 E).

The specimens are not entirely white (spurs pink, labellum purplish with purple dots) and differ in this respect from *O. pictus* var. *albiflorus* (Boiss.) Renz. recorded from Syria.

Orchis coriophorus Linn. (Sect. *Coriophoranthus*).

The Palestinian specimens probably belong to var. *pseudofragrans* Nevski which is reported (Flora of U.S.S.R. 1935, IV, 682) from Transcaucasia, Talysh, Persia, and Syria. The flowers have a pleasant smell. The leaves are 1–2·5 cm. wide. Our specimens are from marshy places in the Esdraelon Plain (Tel Yoseph 1924 Eig), the Coastal Plain (Petach Tiqwa, 1922 Eig ; Hedera 1926 Eig) and the Upper Galilee (Peqi'in 1942 Kushnier).

Orchis sanctus Linn. (v.v.s.) (Sect. *Coriophoranthus*).

This species occurs in the batha and garigue of Upper Galilee, Mount Carmel, Sharon, Shefela and Gilead.

Orchis tridentatus Scop. (Sect. *Heranthus*) var. *commutatus* (Tod.) Rchb. f. (v.v.s.).

Rather common in the batha and maquis of the mountainous parts of Palestine (Upper Galilee and Lower Galilee, Carmel, Sharon, Samaria, Judea).

According to Soó var. *commutatus* has an East-Mediterranean distribution ; it differs from the type by the marginate middle lobe of the labellum bearing a short interjected point.

Orchis lacteus Poir. (Sect. *Heranthus*).

The writer did not see this species from Palestine. The specimens recorded in Post's Flora are : *O. tridentatus* var. *commutatus* (Hebron to Jerusalem PH) and *O. sanctus* (Artas D).

Orchis militaris Linn. (Sect. *Heranthus*).

This species, reported from Gilead by Tristram and Paine, does not occur in Palestine. The specimens in question were probably wrongly determined *O. punctulatus*, which occurs in Gilead.

Orchis Simia Lam. (Sect. *Heranthus*).

This species does not occur in Palestine. All specimens from Palestine referred to it belong to *O. galilaeus* Schltr.

Orchis italicus Poir. (Sect. *Heranthus*).

This species occurs in the Lebanon and is found on the northern boundary of Palestine (north of Metula).

Orchis punctulatus Stev. (Sect. *Heranthus*).

The species has been found in Palestine in Gilead (Env. of es-Sueli, 1929 E Z) ; three hours south-east of es-Salt (1911 Meyers and Dinsmore DiH).

The occurrence of this East-Mediterranean–Irano-Turanian species in Palestine was questioned by Schlechter (1928). Soó (1932) records for Palestine only *O. punctulatus* ssp. *galilaeus* which is synonymous with *O. galilaeus*.

Orchis galilaeus Schlt. (v.v.s.) (Sect. *Heranthus*).

Rather common in the batha and maquis of Palestine (Upper Galilee, Carmel, Samaria, Judea). Recorded by most Palestinian botanists under *O. Simia* Lam.

Orchis saccatus Ten. (v.v.s.) (Sect. *Andranthus*).

This species is not recorded from Palestine either by Schlechter (1928) or by Soó (1932). It is rather common in the following districts: Shefela, Sharon, Carmel, Esdraelon Plain, Tabor.

Orchis anatolicus Boiss. (v.v.s.) (Sect. *Andranthus*).

This species is rather common in the Mediterranean territories of Palestine in the batha.

Orchis laxiflorus Lam. ssp. *Dielsianus* Soó (v.v.s.) (Sect. *Andranthus*).

This is the common orchis of the marshy places of both Cis- and Transjordania. From Transjordania only one record by Tristram from Gilead has been available till now. A specimen from el-Azraq (1937 Dinsmore DiH) has been examined by the writer.

Orchis paluster Jacq. (Sect. *Andranthus*).

This species does not occur in Palestine.

Orchis ibericus MB (Sect. *Iberanthus*).

The only specimen recorded in Post's Flora from Palestine (Samaria) was collected and labelled by Fox, whose geographical data are unreliable. The occurrence of this species in Palestine is thus dubious.

Orchis incarnatus Linn. var. *olocheilos* Boiss. (Sect. *Klingeanthus*).

The specimen from Samaria (by Fox in Post's Herbarium), as well as several specimens from Syria, all recorded in Post's Flora (1933), have been identified as *O. laxiflorus* ssp. *Dielsianus*.

No species of subgenus *Dactylorchis* has been found till now in Palestine. The number of species belonging to the genus *Orchis* in Palestine is ten.

Epipactis latifolia All.

This species is mentioned from Palestine only by Eig (1932). Neither Post (1933) nor Schlechter (1928) record it from this country. We possess specimens from the maquis of Upper Galilee (1926 E Z, 1942 F).

Epipactis veratrifolia Boiss.

This species, endemic in the East-Mediterranean (Asia Minor and Syria) has been recorded from Palestine only by Tristram from Galilee. It is probable that it has not been found again till now, because of its flowering as late as August.

Cephalanthera longifolia (Huds.) Fritsch.

Found in Upper Galilee, on Mount Carmel and in Gilead in the shade of maquis and of *Pinus halepensis* forest.

Limodorum abortivum (Linn.) Sw.

This parasitic orchid occurs in Palestine in the region of the *Quercus calliprinos*–maquis and *Pinus halepensis* forest.

LILIACEAE.

Scilla Hohenhackeri Fisch. et Meyer.

C : Mount Carmel near Yagur (1942 Kushnier). UG : Ailon (1940 F Z).

The plant reported by Tristram and then by Post from Mount Carmel and Tabor under *S. cernua* Red. is probably identical with *S. Hohenhackeri*. *S. cernua*, synonymous with *S. siberica* Andr., does not occur either in Palestine or Lebanon.

Eremurus libanoticus Boiss. et Bl.

M : Amman to Ziza (1929 E Z). E : 23 km. south-west of Ma'an (1936 E F Z).

This plant deserves, in the opinion of the writer, a specific rank. The true *E. spectabilis* does not occur in Palestine.

GRAMINEAE.

Anthistiria ciliata Linn. fil.

UJ : Kinnereth (1941 R. Shafrurith).

This is the southernmost station of this species.

Poa persica Trin.

The writer has not found this species in Palestine, and doubts whether it occurs here at all. The specimen from Ajlun recorded in Post's Flora (1933) and examined by the writer is *P. trivialis*. This last has not yet been recorded from Transjordan.

Glyceria plicata Fries.

This species does not occur in Palestine. The specimen from Ras ul Ayn recorded in the revised edition of Post's Flora is *Catabrosa aquatica*.

PROCEEDINGS OF THE GENERAL MEETING

22 February 1945

held jointly with the Zoological Society of London

Mr. A. D. Cotton, O.B.E., President,
in the Chair.

The Proceedings of the General Meeting held on Thursday, 8 February 1945, having been circulated, were taken as read and confirmed.

The following were thanked for gifts made to the Library since the last meeting :—Dr. Annie Porter, Mr. I. H. Burkill, Dr. V. J. Chapman and Professor F. E. Fritsch.

The President reported the death of Mr. William Edward Nicholson, Fellow of the Society.

The following communications were read and discussed :—

The Land's End and beyond. (A film in colour with commentary by Mr. JOHN CHEAR.) (Discussed by Mr. N. B. Kinnear and Mr. Eric Hosking ; Mr. Chear replied.)

Mr. PAUL DE LASZLO. Colour photography as applied to Biology : (1) The case for Colour Photography ; (2) The principles of Colour Photography ; (3) the technique of Colour Photography. [Printed in full below.] (Discussed by Mr. F. W. Coppin, Mr. Eric Hosking, Mr. A. J. Wilmott, Mr. J. Chear, Dr. F. E. Zeuner, Mr. Gerald Atkinson and Dr. J. Ramsbottom ; Mr. de Laszlo replied.)

Ethiopia. (A film in colour with commentary by Mr. C. G. HOPE GILL.) (Discussed by Dr. Hugh Scott, whose remarks were read by Dr. Malcolm Smith, Mr. I. H. Burkill and the President ; Mr. Hope Gill replied.)

COLOUR PHOTOGRAPHY APPLIED TO BIOLOGY

By PAUL DE LASZLO.

The case for colour photography. Colour is of the essence of all matter. Any picture in two dimensions which is not in colour is no more than a series of conventional symbols. It is not truly speaking a reproduction. This is so whether the picture be a photograph or a drawing. Objects do not have outlines as convention allows in drawings. The outline of an object is provided in fact by the contrast in the nature of the light reflected from the object to that reflected from its surroundings. This change in the nature of the light is for the most part a change in its colour. A black and white photograph does not provide you with so-called 'outlines' as in drawings, but again there is recourse to convention, for the colours of the surfaces photographed are represented by a greater or less degree of monochrome shade. We are so used to the colours of objects with which we are familiar that we accept these conventions without realizing that if we did not already know what colours they were intended to represent it would be quite impossible from a study of a photograph to know what they were. If, for example, a man from Mars were to be sent a specimen of the portrait photographer's art, he could not know that the darkness of the lips indicated redness.

If the service photography can render to biology is to record natural objects for purposes of identification or to exchange information regarding new types with foreign countries there is only one answer—colour photography. Take some examples : I defy any mycologist to distinguish between *Amanitopsis fulva* and *Amanitopsis vaginata* by a study of black and white photography. Such an example could be multiplied indefinitely from the plant kingdom. Among animals I grant that colour alone is seldom the only means of distinguishing between varieties. At the same time I doubt whether a collection of black and white photographs would be of very great value to the entomologist, and the importance of

colour in diagnosis of disease is unquestioned. Again, as an example from the field of ornithology I am informed by Mr. J. D. Macdonald that one can only distinguish between the European and Siberian starlings by the fact that the former has a green sheen and the latter a purple sheen on the head.

I have often been asked if the colours in colour photographs are permanent. The answer is that practically every pigment known to man is subject to colour change, especially if continually exposed to light. All colour photographs, whether they be the original transparencies or reproductions therefrom are as accurate and permanent as the dyes used in their manufacture. In this respect colour photographs are neither better nor worse than hand-painted pictures. As we know, many of these have lasted with comparatively little change of colour for centuries. I have many colour photographs that I took more than twenty years ago, and there is no deterioration of colour.

Another question that is frequently put is not so easily disposed of, and raises a problem which is itself difficult to formulate. It can be epitomized in the form of the following question :- ' Are colour photographs of natural history subjects better than colour illustrations by competent artists ? ' The answer is that a competent colour photographer can produce a better result than an artist, unless the latter is in the very top rank of artists. Such an artist could, of course, command a price which he would not be likely to receive as an illustrator of books on natural history, and he can therefore be ruled out for our purpose. A properly exposed colour picture will faithfully reproduce what the camera has seen in shape and colour. An artist, be he never so skilful a draughtsman, will not reproduce what he sees, unless he be exceptionally gifted and rigourously trained. The explanation for this difficulty is, of course, that the human being, when viewing an object and assessing its colour makes an automatic compensation for the source of light by which he views it.

A piece of white paper, as we all know, is white because it has the physical property of reflecting light of every colour. What we often forget is that a piece of white paper viewed by ordinary ½ watt electric light reflects four times as much red light as blue, because it is the ratio in which light is cast upon it. By noon sunlight the same piece of paper reflects more of blue or green than of red. Again, at noon, but in shadow, the red content of the light is further reduced. Under each of these different conditions the piece of white paper is in fact of a totally different colour, and this without taking into consideration the further complication of light reflected in varying colours from surrounding objects ; yet to the ordinary observer it is always white. By a wonderful psychological adjustment compensation is made to adapt the consciousness to the light source. Obviously what I have said is familiar to everyone as an intellectual proposition. I make no apology for repeating it, however, because like many propositions, it is seldom fully accepted in practice. Many a person who understands this theory will nevertheless examine a portrait by a conventional and non-impressionist master, and will comment in astonishment on a green shadow in the face. The shadow in the original almost certainly was green. A child would have

coloured an outline of the face in level pink tone. A skilful adult would have added more variety. Only a master sees the subject as it is and inserts all the varied colours and tones which are in fact reflected. This lack of skill is abundantly evident in all biological text-books from Sowerby onwards.

The colour photograph, being an accurate colour reproduction of the original, will show it in different colours according to the source of light. Fortunately, however, the psychological adjustment to which I have referred, will operate when viewing such a photograph as efficiently as when viewing the original scene. Many indications in the photograph will give clues obvious or subtle as to the source of light by which it was taken. These clues will be intuitively appreciated and allowance will be made. All that the photographer has to do is photograph the biological object as it is. In this regard he will fail only if he attempts to create the impression that the source of light is other than what it is.

The elementary principles of colour photography.—There are two classes of colour photography which can be easily practised by the amateur. That based on the principle of additive colours and that based on the principle of subtractive colours.

The former system depends on the psychic phenomenon that if a fine mosaic made up of varying proportions of the three additive primary colours be projected on to a screen the whole range of the visible spectrum can be reproduced.

The latter system also covers the spectrum but does so by means of the three colours complementary to the three primary colours (i.e., the three subtractive colours) being superimposed on each other in varying proportions.

Many famous additive processes have been available to the amateur since the beginning of the century, such as Joly, Lumière Autochrome and Filmcolour, Paget, Finlay, Agfa and Dufaycolor. The only present-day survivor of a much longer list that I have mentioned is the Dufaycolor process, although I do not doubt that when France has recovered, Lumière material will again be obtainable.

The list of names associated with the subtractive process is also considerable, but again there is only one practical survivor for the task under discussion, and that is Kodachrome.

We are thus left with Dufaycolour in the additive field and Kodachrome in the subtractive field. Subject to the usual war production difficulties material for either process is available to-day in all sizes from the miniature 35 mm. format upwards. Using these two systems as exemplars of their respective classes of colour photography, let us examine in slightly more detail the underlying principles involved.

A Dufay film is made up of the usual gelatine base on which is mechanically printed a microscopic mosaic of rectangles in the three additive primary colours, namely, violet, green and orange. On top of this is spread a panchromatic photosensitive emulsion. The photograph is taken with the film loaded with the sensitive side away from the lens, so that light has to pass through the mosaic before reaching the emulsion. Let us suppose that a wholly violet object is being photographed. The violet rays will be prevented from reaching the emulsion by the green and

orange parts of the mosaic, and will do so only through the violet parts. If the film is now developed and viewed by transmitted light, there will be a minute particle of opaque silver behind each of the violet rectangles where the emulsion has been affected by light, whereas it will be clear and translucent behind each of the green and orange rectangles. In other words the film will look yellow, being a mixture of green and orange, with the violet excluded. If now the film is chemically reversed by dissolving the silver particles, and then exposing to light and developing the remaining emulsion behind the green and orange rectangles, the film when viewed by transmitted light will be a faithful representation of the original violet subject photographed.

By this method beautiful and accurate photographs of the coloured objects can be obtained with a minimum of difficulty. There are, however, two considerations to bear in mind. The existence of the coloured mosaic or reseaux, as it is known, and the fact which will be obvious from what I have said above, that when one of these transparencies is viewed, only one-third of available light passes through it. We will refer to these two points later.

Let us now consider Kodachrome and the subtractive process. A Kodachrome film is a tripack consisting of three panchromatic emulsions coated one on top of the other. The top emulsion is so treated that it is sensitive to one of the three primary colours only, but at the same time allows the other two to pass through it. The second layer is sensitive to one of the two colours which have reached it as described, and allows the third to pass through. The third emulsion is sensitive only to the remaining one of the three colours, namely that which reaches it. The film is processed after exposure in such a way that each of the three emulsions is replaced by a monochrome positive image in one of the colours complementary to that to which it is sensitive, i.e., yellow, magenta or blue-green. If an orange object were being photographed, for example, the layer which would represent the blue component would be colourless, whereas the other two layers would in effect consist of a magenta and a yellow photograph of the object, superimposed one on the other. When viewed by transmitted light, only those rays capable of passing through magenta and yellow would reach the eye, i.e., only orange, and so you would get a photograph of the object in its original colours.

Now please note that the whole of the available light would pass through and that there would be no reseaux or mosaic of colours as in the case of the additive processes.

Which of these processes then is the better from our point of view, Kodachrome or Dufaycolor ?

It is just as easy to take photographs with either. The speed of each is the same, the faithfulness of colour reproduction is excellent in either I have taken a large number of pictures using both systems, and although in fairness to the British system of Dufaycolor I must tell you that there are photographers who prefer it to its American rival, in my judgment Kodachrome wins the day. The reasons are two-fold. As we have noted, a Kodachrome transparency by definition transmits three times as much light as a Dufaycolor. If you wish to project your pictures on to a screen for lecture or other purposes, you can employ in the case of

Kodachrome a small and easily portable projector which has in it a 250-watt lamp. To achieve the same result with Dufaycolor you require a 750-watt lamp which involves an altogether more complex and larger type of instrument similar to the old-fashioned magic-lantern. The other reason for which I favour Kodachrome is that you are not troubled with the reseaux or mosaic of colours. In spite of the amazing skill which the manufacturers of Dufaycolor have shown in the making of their material (the smallness of the reseaux is such that there are about 1,000,000 rectangles to the square inch) —the reseaux is still apparent when you project pictures of the 35 mm. size on to the screen. This is also troublesome when you wish to make enlarged reproductions of the original transparency, either for publication in a book or as single-colour photographs.

The technique of colour photography. —There is nothing which the black and white photographer can do which the colour photographer cannot do. Colour photographs on paper enlarged to any size can be produced from the original transparency. The transparencies themselves make first-rate lantern-slides with the advantage which you will see later of increased portability. Cinematograph films of standard or sub-standard size can be made where circumstances demand. Separation colour blocks for book printing can be made. In fact, anything photographic can be done, and the cost is only slightly greater than for black and white. Furthermore, I stress that taking a colour photograph is no more difficult than taking a black-and-white photograph. All that is required is a greater degree of care in ascertaining the correct time of exposure and in seeing how the subject is lighted.

Let us deal first with the best type of equipment to employ. We are using Kodachrome and the finished transparency is as we have noted, clear and relatively grainless. In this respect it has an advantage over black-and-white photographs. Whatever care you may take, a black-and-white negative suffers from a greater or less degree of graininess which becomes a trouble when you make an enlarged reproduction. In the case of Kodachrome you can use a miniature camera taking 35 mm. film, which will make lantern-slides of an amazing portability when compared with the standard size of lantern-slide. As we have also noted, this enables you to use a small and portable projector. These tiny transparencies can be enlarged up to any reasonable size for making single paper colour prints or book illustrations without noticeable loss of definition or quality.

What is the advantage of using a miniature camera, apart from the question of convenience in weight and space ? It is that you can employ lenses of short focal length. In natural history photography it is important that all planes of the scene photographed should be sharply focused. You want the background to be sharp so that the natural environment can be seen. Again, if a small object such as an insect fills the entire picture, it is important that all parts of the animal should be equally in focus.

Now the depth of field which can be sharply focused is directly proportional to the aperture of the lens. In other words for most subjects the lens should be stopped down to as small an aperture as possible.

It is, however, a fact that for a given aperture a lens of short focal length transmits more effective light to the film surface than one of longer focal length. In other words, for a given aperture of, say, $\frac{1}{2}$ cm. the exposure required for a suitable quarter-plate lens would be 9 times as long as that required for an equivalent 35 mm. format lens. In either case the depth of field would be the same.

In short, where colour photography is concerned, everything, speed of exposure, depth of field, portability, cost of material, indicates the miniature camera.

Now the question arises as to what type of miniature camera to use. There was, before the war, a large variety of first-class instruments from which to choose—Leica, Contax, Contaflex, Retina, Kine-Exakta were the best known. All of these can be obtained to-day second-hand, and I have no doubt that an even greater variety will be available after the war. I have used them all, and I consider that for our purpose the Kine-Exakta made by Messrs. Ihagee of Dresden is the best. This is the only miniature camera making use of the true reflex system, and therefore the only one which enables you to focus and compose your subject. All the other makers supply extension tubes and distance meters and view finders, for focusing on near objects, but all of these suffer from the handicap of parallax, i.e., the view-finder is separated from the lens. You may adjust your view-finder so that a point at a specific distance from the camera is seen in the same way as it is seen by the lens of the camera, but this does not apply to other points in the same plane, nor to points in other planes. Assuming that you are photographing a small fungus life-size ; unless you can use the lens of the camera to compose the picture it is quite impossible to know what is going to be included in it, or whether part of the fungus will be obscured by part of the foreground, or whether some objectionable background will come into the photograph.

Now let us proceed to the taking of the photograph. I have said that there is no greater difficulty in taking a colour transparency than in taking an ordinary black-and-white photograph. All that is required is greater care in judging the time of exposure and arranging the lighting. Care is required in both of these respects, because the Kodachrome emulsion has less latitude than the black-and-white emulsion. With a non-colour emulsion of average speed if an exposure of 2, 3, 4 or even 8 times the correct time be given, a perfectly good negative may nevertheless be produced. This not only means that it is not necessary to be very accurate in assessing the correct exposure time, but which is more important, a greater range of lighting can be included in a single picture. In other words, if you photograph a subject with bright sunlight falling on it from the side, a negative can be produced giving correct tonal values both in the highlights and in the shadows.

Unfortunately, the latitude of Kodachrome (and of any other colour single film) is only about 2 to 1. If you give more than twice or less than half the correct exposure you will not get a satisfactory picture, and, which is more troublesome, you will be unable to get a good photograph at all if the light range of your subject covers a wide scale. Studies in light and deep shadow are ruled out altogether. Side-lighting is

practically taboo. Direct sunlight is only permissible if it is frontal or if the shadows are filled by reflected light. The limitation of range is not so much due to the loss of detail in incorrectly exposed parts of the picture, as to completely false colour rendering, which, of course, ruins the result.

Let us see how each of these difficulties, inherent in single-film reversible colour photography processes, can be overcome.

The answer to the exposure problem is to use one of the many available varieties of photo-electric exposure meters. Personally I use a Weston Universal meter, and I set the film speed indicator at 6 for daylight. Let me say here that I intend to deal only with daylight photography. As I have said, perfectly good colour rendering can be obtained by flash-light or by electric light, but I have never yet seen a colour photograph by artificial light which was not obviously taken by artificial light. This, of course, is as it should be, but the majority of natural history subjects are normal in daylight, and owing to time limitations I will confine myself to this. You must also take into careful consideration the increase in exposure necessitated by taking pictures near life-size. Any elementary text-book will give you tables with exposure factors for near subjects simply set forth.

Now as to the lighting. What you must aim at is flat lighting. Ideal conditions are when light cloud covers but does not obscure the sun. Do not attempt side lighting, and try to reflect light into any shadows which may exist, by e.g., the use of a pocket handkerchief. In black-and-white photography, such technique would result in flat uninteresting pictures. In colour photography the contrast and interest are provided by the colour itself. In this connection the background is a matter of the greatest importance. It must be selected to be typical of the environment of the subject photographed, and at the same time providing a suitable colour contrast. Again, the background must be illuminated to approximately the same degree as the subject owing to the small speed latitude of the film, to which I have alluded.

What I have attempted to convey to the meeting is that colour photography is not difficult. The requirements are no more than those for a tolerably skilful and careful black-and-white photographer. I am convinced that a realization that the technique of colour photography can easily be mastered will lead to its universal adoption for all biological purposes.

Discussion.—

Mr. A. J. WILMOTT said that his short experience of colour photography —with *Salicornia* just before the war—had taught him a few lessons which might be worthy of mention. Salicornias have very little relief, and he had noticed that the reason why a photograph often seemed unsatisfactory was that in examining a specimen under a lens, he twisted and turned it so that all available light and shade obtainable from various directions of lighting was utilized and combined mentally, whereas the photograph registered a single view only. A good artist was often able to combine into a drawing something learnt from such view-points, and

in this way to provide an illustration which might be more helpful to a student than a single photograph ; but this was possible only if the artist had sufficient knowledge of the subject. Flat lighting did not help to bring out the little relief that the Salicornias possessed. His photographs were made in a specially constructed box, in which the camera (Leica) was in fixed position and the planes of focus and actual fields (for the three *Bemar* extensions) absolutely known and marked out. The specimen was fixed to an adjustable stand which could be brought up into the exact field and plane of focus, with guaranteed precision. The lighting, from a projection lamp at the side, gave the maximum of relief, and the suggested disadvantages of this side-lighting were neutralized by the use of a mirror on the side opposite to the lamp : the further away a point was from the lamp the nearer it was to the reflection of the lamp, and vice versa, so that sufficiently even lighting was in fact obtained. Under these conditions uniformity (regularity) of lighting could also be guaranteed, so that with a given brand of film it was possible to say, e.g., that 13 seconds gave a better result than either 12 or 14. [This optimum was ascertained by a series of exposures of the same subject.] Thus although it might not yet be possible to obtained *absolutely* correct colour representation, one could by such uniform lighting guarantee *relatively* correct representation, and be able to record that this flower was redder than that, or brighter red, or duller, or darker, and so on, which was most valuable and quite adequate for critical comparison.

OBITUARIES.

Frederick Robert Stephen Balfour, C.V.O., F.L.S., V.M.H., a son of Alexander Balfour of Leven, Fife, was born at Mount Alyn, Rossett, in Denbighshire, on 11 March 1873, and there spent his early childhood, his father's business being in Liverpool. Not long after the death of his father, in 1886, Mrs. Alexander Balfour returned to her native Scotland, and Fred, her eldest surviving son, was sent to Loretto School in January 1887, and afterwards went up to Trinity College, Oxford, where he took his B.A. degree in 1896. Next year his mother purchased the house and estate of Dawyck, Stobo, Peeblesshire, which from then became the country home of the family.

The estate is in hilly country with an elevation of 600 to 2,700 feet above sea-level. These lands of Dawyck were held from the thirteenth to the end of the seventeenth century by the Veitch family, and later by Naesmyths of Posso, in the neighbouring Manor Valley.

Sylviculture has a long history at Dawyck. Here, about 1650—in the Veitch period—horse chestnuts were introduced to Scotland. Sir James Naesmyth, the second baronet, planted European larches there as early as 1725, several of which still exist. And from 1840 onwards, Sir John Murray Naesmyth, the fourth baronet, who was a friend and pupil of Linnaeus, introduced to Dawyck many fine conifers from NW. America.

From the year 1900 Fred Balfour spent some four years in business in NW. America, and there saw growing wild some of the great coniferous trees that he had known in cultivation at Dawyck. This experience stimulated his enthusiasm, and directed along arboricultural lines his passion for making collections. From then on he determined to carry on the arboricultural traditions of Dawyck, so well begun by his predecessors, the Veitches and Naesmyths.

In 1904 he married Gertrude, daughter of the late F. H. Norman of Moor Place, Much Hadham, Herts, and then took up work in the City of London. This, however, did not prevent him from spending as much time as possible at Dawyck. On several subsequent short business trips to NW. America he succeeded in arranging visits to mountainous regions. There he collected seeds of coniferous and hardwood trees and shrubs, and also young wild lifted seedlings, all of which he brought home to Dawyck or distributed to botanical gardens or among his friends. With the aid of his younger brother, Archibald Roxburgh Balfour, then in business in Valparaiso, he obtained seed of some of the Southern beeches (species of *Nothofagus*) from South Chile. Perhaps the most striking and beautiful of his introductions is Brewer's weeping Spruce (*Picea Breweriana*), a tree found wild only in remote regions in the Siskiyou Mountains of NW. California and SW. Oregon. The young trees that he brought back in 1908 grow well at Dawyck and reached the coning stage about thirty years later. (See Bot. Mag. t. 9543.) Before 1908 the species had been represented in Great Britain by one small tree only, in Kew Gardens. Among the illustrations in Dallimore and Jackson's 'Handbook of the Coniferae' are some of Balfour's photographs of

Brewer's spruce and other trees growing wild in NW. America; and, in their 'Trees of Great Britain and Ireland', Elwes and Henry also show one by him of *Pinus Lambertiana* in California.

Balfour not only endeavoured to grow all the conifers obtainable and likely to thrive at Dawyck, but also tried out, under forest conditions, the more promising species—a work of great value in experimental forestry. Thus, in the early years of this century many acres were planted with Sitka Spruce, Japanese Larch and Douglas Fir; and since then smaller plantations have been made of Lawson Cypress, *Picea asperata* from China, *Picea Omorika* from the Balkans and other species. Nor were hardwood trees neglected. Of all the Dawyck trees the fragrant *Populus trichocarpa* grows most rapidly, rising to eighty-five feet in thirty years. In 1942 a specimen of it was felled at the request of Messrs. Bryant and May, and found to give satisfactory results for the match-making industry. (Scottish Forestry Journal, vol. 57.)

In the policies, besides the older trees, dating from Naesmyth times, are many rare and beautiful trees and shrubs of Balfour's introduction. Specially notable among these is the collection of Rhododendrons. Daffodils of many varieties, planted in drifts in grassland, provide a marvellous spectacle in spring.

Balfour's interest in natural history was, however, by no means restricted to the vegetable kingdom. Besides taking a great interest in British birds, he kept (between wars) aviaries containing rare and beautiful species of pheasant, including Blue Crossoptilon (*Crossoptilon auritum* Pall.), Crimson Horned Tragopan (*Tragopan satyra* L.), and Temminck's Tragopan (*Tragopan Temminckii* J. E. Gray). On the pond were ducks and geese from all over the world, such as Chestnut-breasted Teal (*Anas castanea* Eyton) and Chilian Pintail (*Anas spinicauda* Vieillot). He derived great pleasure in studying the habits of individual ducks and pheasants. Unfortunately war restrictions on food supplies and labour led to the death or dispersal of these interesting collections.

Balfour made various experiments in the releasing of game birds at Dawyck. After vain attempts to raise Capercaillie (*Tetrao urogallus* L.) from eggs, he succeeded in 1930 in obtaining a live pair from Deeside and later some birds from Finland. Since then they have nested regularly; but owing to the recent felling of 300 acres of Scots pine and larch, some have wandered to a neighbouring estate.

All efforts to introduce the Hazel Hen (*Tetrastes bonasia* Keys & Blas) unfortunately failed, but American wild turkeys which have been established are hardier than the domestic breed and do not require to be fed. Easily shot with a rook rifle, they are popular about Christmas time.

He also turned out various pheasants; and Reeves, Amhersts and Crossoptilons were often to be seen near the house. Indian Jungle Fowl were also introduced, but have now disappeared.

In 1901 Balfour imported from NW. America a stag and seven hinds of the Black-tailed Deer (*Odocoileus columbianus* Richardson), a species seldom before tried in captivity. The animals were brought to this country in a sailing ship, via Cape Horn, and became very tame on the voyage. Arrived at Dawyck in midwinter, they were placed in stables

till spring when they were conducted, with some ceremony, into the deer park. They had had little exercise for a year or more. When let loose they walked casually up to the ten-foot fence and one and all jumped it. They subsequently wandered far over the countryside showing no fear of man, but a marked preference for his vegetables and garden flowers by way of diet. It is not surprising perhaps that they all soon disappeared.

A herd of Japanese deer of the Manchurian variety (*Sika mantchuriacus* Swinhoe) has been kept in the deer park for many years. During the first world war some careless person left a gate open ; and some half dozen or so escaped to the adjoining woods, where they increased rapidly at the expense of the native roe deer, which have almost disappeared. They do much damage to young trees by barking the stems with their horns : and some have to be shot each year to keep their numbers in check, though Balfour did not wish them exterminated altogether. As the Dawyck woodlands are somewhat isolated among heather and grass clad hills, the deer do not tend to spread into other districts so long as their numbers are kept low. They provide excellent venison.

During the First World War, Fred Balfour was a member of the Home-Grown Timber Committee and was later sent, as Liaison Officer, to the French Government, to buy Army timber supplies.

In London he was a Director of the Guardian Assurance Company, Cable and Wireless, Ltd., Bank of Montreal and other companies, but also found time for important arboricultural work. He was on the Executive Committee of the Conifer Conference, held by the Royal Horticultural Society in 1931, and on that occasion read an important paper entitled ' The History of Conifers in Scotland and their Discovery by Scotsmen '. Being one of the original members of the Roads Beautifying Association, he sat on their Council and was latterly Chairman of their Technical Sub-Committee. He was for twenty-two years a member of the Windsor Parks Consultative Committee.

Balfour published various papers on Arboricultural subjects, such as ' The Planting and After Care of Roadside Trees ' (Quart. Journal of Forestry, July 1935). Perhaps his most notable papers were on the Scottish botanical explorers David Douglas (R.H.S. Journal, vol. LXVII, parts 4 and 5) and Archibald Menzies. After reading to the Linnean Society, on 8 June 1944, the paper on Archibald Menzies, he presented our library with a transcription of Menzies' Journal of Vancouver's Voyage, in five volumes, bound in half leather made of Japanese deer skin from Dawyck.

Balfour inherited from his father his interest in the welfare of the men in the Merchant Navy, and served for forty-one years on the Committee of the Missions to Seamen and as Honorary Treasurer since 1939. He was fond of music and sang with a fine baritone voice. He was also interested in history, archaeology and architecture, and had a comprehensive collection of old silver, and mazer bowls.

With his many and varied interests he was never dull, and was always genial. Nothing pleased him so much as to be doing a kindness to a friend or relation, even at what seemed to be considerable inconvenience. He lived a happy and useful life to its end, which came after only a few hours of illness, on 2 February 1945.

W. BALFOUR GOURLAY

The death of Professor Eugène-Louis Bouvier on 14 January 1944, removes one of the well-known personalities from the scientific world of Paris. He was born on 9 April 1856, joined the Paris Museum in 1883, and except for the years 1889–95, when he was Professor at the School of Pharmacy in Paris, remained there for the remainder of his life. An old student of Edmond Perrier, he began his active career at a time when evolutionary doctrines were still being contested, and he belonged to the older generation of zoologists who seemed to have an almost encyclopaedic knowledge of the animal kingdom. His published work includes a long list of important papers, mainly on Decapod Crustacea, but his activities ranged over many other kinds of animals, his thesis to the University of Paris, presented in 1889, being devoted to the anatomy of Cetaceans. His monograph on the Onychophora is well known to all students of this Class. His researches on the Atyidae, begun in 1903 and finished in 1917, comprise studies on evolutionary mutations and the geographical distribution of this Family, in addition to details of classification. He was also a world authority on the Pycnogonidae.

Bouvier, nearly half a century ago, was appointed to the chair of articulate animals at the Muséum National d'Histoire Naturelle de France, and from his laboratory came a stream of important papers almost until the present war. He became interested in the habits of certain Hymenoptera about 1900 when he began to publish papers on the problem of instinct and behaviour in insects, and in later years devoted much of his time to this subject. One of his best known popular works, 'La Vie Psychique des Insectes', was written in the middle of the last war, during which he lost two of his children. Dr. L. O. Howard, who translated this book, records that it was written during those trying times, in the effort, to use Bouvier's own words 'pour oublier les angoisses de patriote et de père'.

Bouvier retired from his official post at the Museum soon after the last war, but continued to work on insects, especially the Saturniidae, and published a Revision of the Saturniinae in 1936. For many years up to the time of his death he was editor of the Zoological section of the Annales des Science Naturelles. He was a member of the Institute and Vice-President of the French Academy of Agriculture; in addition he had received numerous academic distinctions both at home and abroad. In 1936 a Jubilee Volume was prepared by 74 of his former collaborators, pupils and friends: 'en hommage de leur affectueuse admiration'. He was elected a Foreign Member of the Linnean Society in 1904.

Edward Hindle.

Gustave Gilson (1859–1944) died in Belgium on 1 January 1944. He will be mourned by many who knew his courtesy and who claimed his friendship. Among those are Fellows of this Society whose interests range from microscopy to problems of marine biology. It is good to be able to record that, despite the occupation of their country by hostile forces, his Belgian colleagues found expression for their sense of loss.

Gilson entered the University of Louvain in 1878 as an intending student of medicine; and this at a time when biological instruction by laboratory methods was a new and surprising experiment in teaching

practice. Under the early guidance of Van Beneden, Martens and Henry he came to know immediately that the doors to discovery are ever open and inviting to master and pupil alike. His first year of study was scarcely complete until he turned from his initial purpose and aspired to a career in research.

He soon came under the notice of Carnoy, who had recently founded courses of instruction in 'practical microscopy' as the first of their kind in Belgium. Thus there began a close association and a lasting friendship which sprang from Carnoy's conviction that he had found a meticulous observer who could well be trained to be his successor. Within three years Gilson became an assistant to Carnoy, with whom he planned the future Carnoy Institute.

The Degree of Doctor of Science of his own University was granted to Gilson in 1883, and his early attainments and industry in microscopy were recorded by Carnoy in 'La Biologie cellulaire' of that year. There followed immediately his appointment as assistant to Van Beneden, who chose him as his first teacher of comparative embryology on modern lines.

In 1885 Carnoy and Gilson decided on the first issue of 'La Cellule', so that the histological and cytological studies of their forming School might be published progressively in memoir form. They were joined later in this important enterprise by Victor Grégoire and his botanical associates, who thus broadened and strengthened the plan of study and whose attainments in cytology came also to draw students to Louvain from many lands.

By 1887 it was apparent to both Carnoy and Gilson that new laboratories must be secured if, as in their view, 'everything relating to cytology and histology' was to be represented in their University. With generous help, they secured the old College of the Abbeye de Villers as the basis for their projected Institute. Some measure of their success is given by the fact that over 450 memoirs on histological and cytological subjects had emerged from L'Institut Carnoy before the close of the year 1936. Many of these publications came direct from Gilson: a goodly number were from his personal pupils.

In 1889 Gilson succeeded Van Beneden in the Chair of Zoology and Comparative Anatomy, and during the six succeeding years he was engaged in what were, perhaps, his most exacting endeavours as a teacher and editor, investigator and organizer. His work of this period led Dupont, the then Director of the Royal Natural History Museum of Brussels, to urge him to turn towards the needed study of the fauna of the Belgian coast. Gilson entered tentatively on this work in 1896 and, having first gained some insight into its nature at Naples and elsewhere, he proceeded to measure his commitments by personal observation of the oceans during a voyage around the world. Like many others who had thus been drawn towards the study of marine biology, he returned from his travels convinced of the need of research stations, particularly in relationship to the problems of coastal waters. By 1899 he had equipped a modest laboratory at Ostend and had taken the first serious steps towards the preparation of a faunistic record for the Belgian coast. Until the outbreak of war in 1914, Gilson worked more or less persistently

on fishery matters and did much to encourage a scientific approach to them. His work in this direction was quickly appreciated and led to his election in 1903 as Belgian representative to the Permanent International Council for Marine Exploration. It was in part through his constant and sympathetic contacts with this Council in Copenhagen that his qualities as a colleague and as a friend came to be valued by many British workers. His international relationships were also broadened following his appointment in 1909 as Director of the Royal Museum of Natural History in Brussels. He held this post with distinction until his obligate retirement at the age of sixty-five.

But despite a heavy responsibility in administration, he maintained his contacts with the University of Louvain and found time for his marine studies and for preparations for a future biological station on the Belgian coast. This latter project might well have been realized but for the outbreak of war in 1939.

Those who knew Gilson between 1919 and 1938 were as much impressed by his unflagging interest in all that relates to microscopy as had been others by the range and exactitude of his earlier studies. Between 1885 and 1936, some eighty-five publications, mainly on histological and fishery subjects had come from his pen. Many of these were important memoirs which will for long be standard works throwing light on spermatogenesis, the nature and functions of glandular systems, and a large variety of fishery problems. Even a minor matter regarding him should be recalled, since the preparation of euparal as a mounting medium was among his early achievements. J. McLean Thompson.

William Edward Nicholson (1866–1945). The passing of W. E. Nicholson within a year of his lifelong friend H. N. Dixon deprives the Linnean Society of another of its most eminent bryological fellows. Nicholson's knowledge of the British liverworts was unsurpassed and he added several species to our flora. As an authority on the taxonomy of European mosses and of the Hepaticae, European and exotic, his reputation was world wide.

W. E. Nicholson was born on 24 March 1866, at Lewes, Sussex, where nearly all his life was spent. His father, Edward Andrews Nicholson, was a partner in a firm of solicitors in the town; his mother, Emily Louisa Blaker, belonged to an old Sussex family. When only eleven years old he was sent to Marlborough, but in his early teens an attack of pneumonia made it necessary for him to leave and he completed his education under a private tutor. After studying law for a short time in London, he entered his father's firm, in which he remained an active partner until 1930.

From his earliest years Nicholson was passionately interested in natural history and until middle life he was as much an entomologist as a botanist. At the time of his death he had an excellent collection of British Lepidoptera and at one time he had a European collection. Before 1890 he became interested in mosses and liverworts and received help and encouragement from William Mitten, the veteran Sussex bryologist, at that time the greatest authority in this country on the exotic mosses. From then onwards Nicholson gave much of his time to the study of bryology, in spite of the calls of his professional work. In the diary which he kept for many years he records how hardly a day passed without his spending some time

on his favourite pursuit, either in the field or in his study. He explored the Sussex countryside minutely, and in his admirable account of the hepatics of the county ('Hastings and East Sussex Naturalist', I, 243–93, 1911) the large number of species recorded is as much a testimony to Nicholson's thoroughness and keen eyes as to the richness of the flora. His intimate knowledge of many of the rarer liverworts was largely due to his practice of cultivating imperfectly known species in his greenhouse.

Nicholson had a great love of foreign travel and visited many parts of Europe, including Lapland, Crete, Sicily and southern Portugal. Most of these journeys were made in company with his friend Dixon and all of them, especially the visit to the Algarve in 1911, were extraordinarily productive of interesting bryological discoveries.

In the war of 1914–18 Nicholson served with the local volunteers and bore a very heavy burden of professional work; the strain of these years was probably largely responsible for the heart trouble which incapacitated him more and more during the rest of his life. When no longer able to continue the long walks and bicycle rides of his younger days, he continued field work with the help of a car, and was still active up to the beginning of the present war. In 1940 he left Lewes and spent the last years of his life in Cornwall; he died at Mullion on 13 February 1945, and is buried in the churchyard of Landewednack.

Nicholson once confessed that he would have liked to have held a appointment, and certainly had circumstances led him to become a professional botanist his gifts would have made him sure of success. He had an exceptionally clear and critical mind, and the acuteness of his powers of observation was phenomenal, as is witnessed by the number of species *Cephaloziella* he discovered, many of which have been found by very few others. He wrote a considerable number of short papers, mainly on his discoveries in Britain and abroad. In his later years he was chiefly occupied with exotic hepatics, and his chief contribution in this field was his account of the Chinese collections of the Freiherr von Handel-Mazzetti published in 1930 (Symbolae Sinicae, v, 1–35, 1930). His name is commemorated in the moss, *Barbula Nicholsoni* Culmann and in the liverwort *Cephaloziella Nicholsoni* Douin and Schiffn. His valuable herbarium has been presented to the University of Cambridge. He was elected F.L.S. in 1919, and was President of the British Bryological Society in 1929 and 1930.

Nicholson had a great love for all kinds of natural beauty and achieved wonders in his small and not very promising garden. He was quiet and unassuming in manner and in his later years lived a very retired life. His numerous correspondents will greatly miss his shrewd and illuminating comments and touches of dry humour.

Apart from botany, which engrossed him more and more in later life, Nicholson was keenly interested in archaeology and was for fourteen years secretary of the Sussex Archaeological Society. He did much public service in his native town; with a doctor, he was largely responsible for founding the Victoria Hospital.

He married in 1916 Eleanor Calvert, but had no children.

P. W. RICHARDS.

[Part 1. pp. 1–69, *published December 31, 1945.*]

CONTENTS (*continued*).

Page

Proceedings, 23 November, 1944 4

Polyploidy in *Valeriana officinalis* Linn. in relation to ecology and distribution. By M. Skalińska. [Abstract.] 4

Commemoration of the Lamarck Bicentenary 6

From Linnaeus to Lamarck. By R. Winckworth 8

Time and Lamarck. By F. Wood Jones 11

Contributions towards the Fungus Flora of Uganda.—VII. New Records and Revisions (*continued*). By C. G. Hansford .. 20

Proceedings, 8 February 1945 42

A revision of the genus *Harpochytrium*. By F. W. Jane. [Abstract.] 42

The tetra-radiate spores of certain aquatic Hyphomycetes and the propagules of some species of Sphacelaria. By C. T. Ingold 43

The swimming of Monas (Protozoa). By A. G. Lowndes. [Abstract.] 45

Materials for a revised Flora of Palestine.—I. By N. Feinbrun 46

Proceedings, 22 February 1945 54

The Land's End and beyond. [Film.] By John Clear 55

Colour photography as applied to Biology. By P. de Laszlo .. 55

Obituaries 63